

Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

BULLETIN 218

Farm Crops

RESULTS OF EXPERIMENTS AT ONTARIO
AGRICULTURAL COLLEGE

By
C. A. ZAVITZ, B.S.A.

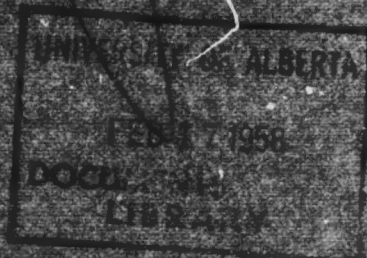
Professor of Field Husbandry

and

Director of Field Experiments



ONE WEEK LOAN



S
540
F5
Z392
1915

TORONTO, ONTARIO, FEBRUARY, 1958

SCI

Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

Farm Crops.

Results of Experiments at the Ontario Agricultural College.

C. A. ZAVITZ, B.S.A.

INTRODUCTION.

Agriculture is the great industry of Ontario. The stability of a Province like Ontario is in its agriculture. Everything which helps the advancement of agriculture tends to assist in the development and the progress of the whole country. If this is true in the time of peace it is especially true in the time of war. The greater the amount of foodstuffs of the right kind and quality produced in Ontario, the better is the position of the Province to give assistance where it is likely to be greatly needed, in Great Britain, Belgium, and other countries. It therefore behooves the farmers of this Province to do the best they possibly can in the present crisis.

More than one-half of the tillable land of Ontario is at present in grass, or in those crops which are used for the production of hay and pasture. About one-half of the grass land is in pasture. Many of the pasture fields are old timothy sods and are very poor in productivity. This is owing largely to the fact that skilled labor throughout the country is scarce.

The number of *skilled farmers* on the lands of the world in comparison with the number of *non-producing consumers* will be considerably lessened owing to the present war.

Major-General Sir William Otter, in his message to the Canadian people, stated as follows: "Above all, measures should be taken to stimulate the production of foodstuffs. One of the greatest services which the Canadian people can render to the Empire at present is to increase our supply of food for the British people. This is at once our duty and our opportunity."

That much is expected of the farmers of Ontario can be seen from the address given by Hon. W. H. Hearst, Premier of Ontario, when he spoke at the Women's Institute Convention held in Toronto a few weeks ago, and from which address he was quoted as saying that "The farmer at work in the field is doing as much in this crisis as the man who goes to the front."

The statements and the references which I have here presented show something of the disadvantage, the responsibility and the opportunity of the farmers of this Province: disadvantage, owing to the fact that skilled labor throughout the country is very scarce; responsibility, owing to the fact that within the next few years there is sure to be a considerable increase in the proportion of humanity who will be in great need of the real necessities of life; and opportunity, owing to the fact that the farmers have it in their power to do a vast amount of exceedingly helpful service for their fellow men, especially of other countries.

If it is true that the progress and the development of Ontario depends largely on its agriculture it might be safely stated that it is equally true that the success of agriculture depends upon the productiveness and the quality of the crops produced on the land. Within the next few years there is sure to be a large demand for all kinds of farm crops, partly to be used directly as human food, and partly to be used as feed for farm stock. It is considered by some of the most thoughtful agriculturists of Ontario that our live stock industry should be increased rather than decreased. If this is true there will be a big demand for farm crops, and wise are those farmers who will so conduct their farming operations in order that the land can give the highest production and the best quality of those crops which will be the most needed. This will involve not only thoughtful consideration of the most appropriate classes of farm crops to produce, but also the use of the best varieties; the careful selection of the seed; the thorough preparation of the land; and the proper sowing of the crops in regard to date of sowing, quantity of seed per acre, method of sowing, etc. The results presented in this bulletin should prove very helpful in supplying useful information for the men who are located on the individual farms throughout Ontario. It is probably safe to say that there is no farmer in the Province but who might be able to secure valuable information from this bulletin to assist him in his crop production in the coming season.

FIELD EXPERIMENTAL WORK.

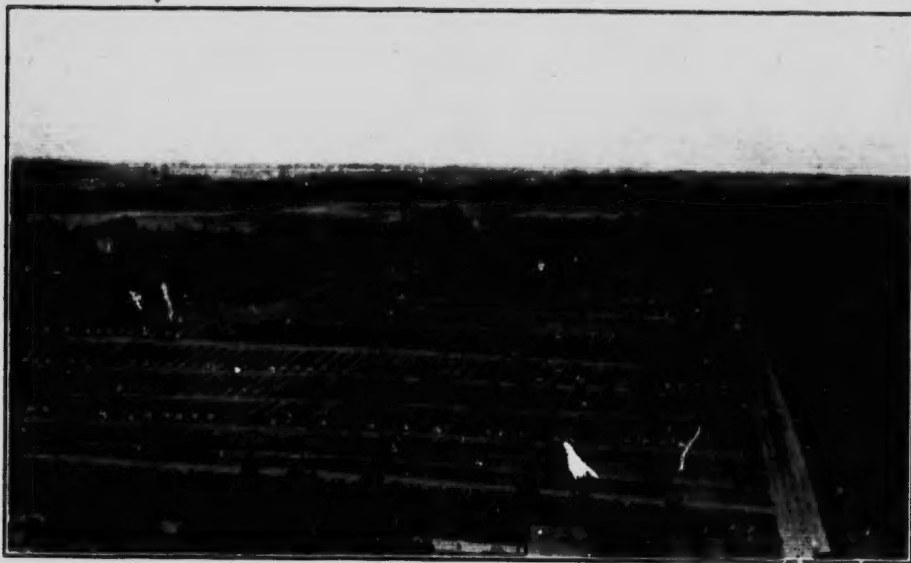
For a better understanding of the results which are to follow we here give a few concise statements in regard to the experimental grounds and the carrying on of the work as conducted in the field plots at the College.

The experimental grounds at the College, which are under the direction of the Field Husbandry Department, consist of about seventy-five acres of land, which are divided into upwards of two thousand plots, and on which experiments are being conducted with varieties of grain, root, tuber, grass, clover, fodder, silage and other crops, with artificial, green and barnyard manures; with methods of cultivation, selection of seed, dates of seeding, mixtures of grains, pasture grasses, etc. In addition the Department directs co-operative experiments on five thousand farms throughout the Province.

A greater portion of the experimental grounds has a gentle slope towards the south-west, and a smaller area has a slope towards the north-east, and the soil is what might be termed an average clay loam. The lower portions of the land contain rather more vegetable matter than the higher sections. The greater portion of the land has a four years' rotation, the rotation being: first, grain crops; second, cultivated crops; third, grain crops, and fourth, pasture. This is a special rotation particularly well suited to the experimental work as carried on at the College. About one-quarter of the land is manured each year with twenty tons of farmyard manure per acre; thus most of the land receives an application of farmyard manure once every four years. The manure is applied previous to the cultivated crops. No commercial fertilizers are used except in distinct fertilizer experiments, and

these occupy a comparatively small area each year. Within the past sixteen years one green crop has been plowed under on each section of the grounds. The plots vary in size according to the requirements of the different experiments, and the yields per acre are determined from the actual yields of the plots in every instance. All of these experiments are conducted with the greatest care, and for several years in succession in order to secure strictly accurate results. These experiments deal with the crops grown on fully nine-tenths of the cultivated land of Ontario. An immense amount of thought and care is required in planning, supervising and examining these plots, and in studying, comparing and summarizing the results for presentation in reports, bulletins, newspaper articles and lectures.

There are possibly but few lines of work in which it is absolutely necessary to use so much care in the details. It is also exceedingly important to repeat the



Partial view of Experimental Grounds showing grain plots, some of which have been cut.

experiments for several years in order to get results which are as reliable as possible. All of our field experiments are conducted for at least five years before they are dropped, and many of them are continued for a much longer period of time. For the results of some of the tests which were carried on for five or more years previous to 1914 the reader is referred to former reports. The results of some of the experiments which have as yet been conducted for one or two years are held over until the test can be carried through for at least another summer. Since seasons vary so much in temperature, rainfall, etc., the average results of experiments continued for several years are of much greater value than those secured from one or two seasons' work. Owing to the great care exercised in the work, and the number of years through which the experiments are continued, we are able to present the results with much confidence in their reliability and in their practical value.

WEATHER CONDITIONS IN 1914.

It is probably safe to say that the weather conditions of the past year have been fairly normal, both at the Ontario Agricultural College and throughout the greater part of the Province. According to the November report of the Bureau of Industries for Ontario we learn that the mean temperature for the ten months from January to October, inclusive, was 46.2, being one degree lower than the previous year and .2 higher than the normal for thirty-two years. The total precipitation for the ten months was 23.3 inches or 3.3 inches below the average. April and August were the only months above normal, all the others being below. July was unusually dry, being 1.4 inches below the average. The rainfall throughout Ontario was somewhat below normal in September and was somewhat above normal in October of last year. The winter was fairly favorable for the autumn sown crops, but a few days of very cold weather after the snow disappeared in the spring did considerable damage to the crops in some localities. The weather conditions of the past summer have been fairly favorable in most localities, although in a few sections the crops suffered from lack of rain.

As it is important for a proper understanding of the results of experiments with farm crops to have a knowledge of the weather conditions in the locality in which the experiments have been conducted, the amount of rainfall in the summer months in each of the past fifteen years is here presented. The amount of rainfall has been carefully determined in each of these years by the Department of Physics at the College, from which Department we have received the information.

INCHES OF PRECIPITATION DURING THE SIX GROWING MONTHS.

Year.	April.	May.	June.	July.	August.	Sept.	Total.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1900.....	1.69	1.08	4.47	3.06	.87	1.52	12.63
1901.....	2.24	3.26	1.53	4.07	3.51	2.45	17.06
1902.....	2.43	1.67	3.06	6.43	2.18	3.58	19.35
1903.....	2.69	2.44	3.05	2.67	3.47	1.48	15.80
1904.....	2.10	3.01	2.86	4.99	3.88	2.80	19.64
1905.....	1.82	3.89	3.24	4.60	1.98	2.85	18.38
1906.....	1.44	2.71	4.06	4.65	2.13	2.49	17.48
1907.....	1.66	2.64	1.11	1.92	.62	2.87	10.82
1908.....	1.33	3.47	3.21	3.25	2.75	.73	14.74
1909.....	3.60	2.43	1.33	4.54	.89	.86	14.65
1910.....	3.13	2.75	.78	1.89	3.18	3.29	15.02
1911.....	1.67	1.64	.89	1.96	2.53	3.42	12.10
1912.....	1.14	5.64	1.51	2.53	6.07	3.08	19.97
1913.....	3.53	1.37	2.03	3.26	2.38	1.49	14.56
1914.....	2.86	2.04	2.76	1.23	4.21	1.96	15.06
Average 15 Years	2.22	2.74	2.39	3.40	2.74	2.32	15.82

An examination of the foregoing table shows that the amount of rainfall at the Ontario Agricultural College during the six months from April to September was 15.1 inches in 1914 and 15.8 inches in the average of the past fifteen years. It will be seen that in the months of April, June, and August the rainfall of the past season was above, while in each of the other months it was below the average. It will be observed that the rainfall in July and also in September was comparatively light, while that of August was the second highest for that month in any one season throughout the fifteen year period. The amount of rainfall at the Ontario Agricultural College corresponds pretty closely with the average rainfall for the Province

of Ontario as determined by the Bureau of Industries from readings taken at Southampton, Birnam, London, Woodstock, Stoney Creek, Toronto, Lindsay, Gravenhurst, Ottawa, and Haileybury.

COMPARATIVE YIELDS OF DIFFERENT CLASSES OF FARM CROPS.

In each of the past fourteen years two leading varieties of oat, barley, spring wheat, field peas, spring rye, hulless barley, and emmer have been grown in our experimental grounds under uniform conditions of soil and climate. The object of this experiment has been not so much to compare one variety with another but to secure definite information regarding the relative productiveness of different classes of farm crops. It is apparently strange, but nevertheless true, that but little definite work has been done at agricultural experiment stations in comparing in this positive and comprehensive way the relative productiveness of our most common grain crops. As the experiment was conducted to duplicate each year it will be seen that we now have the results of twenty-eight separate and distinct tests conducted in the fourteen year period with these seven classes of farm crops. In some years the experiment was conducted on high land, in other years on low land, and in others upon land which had a gentle slope; in some seasons facing the north-east and in others the south-west. On no occasion was this experiment conducted on particularly heavy or on specially light soil, the land on which the experiment was conducted being a loam which varied somewhat from year to year from fairly light to medium heavy. The results of this experiment are very interesting.

The following table gives the average yield of both straw and grain per acre of each of seven varieties of farm crops for a period of fourteen years:

Class of Crop.	Straw (tons)	Grain (lbs.)
Barley	1.68	2,577
Emmer	1.88	2,509
Oats	2.24	2,503
Hulless Barley	1.65	2,328
Spring Wheat	2.06	1,883
Field Peas	1.46	1,772
Spring Rye	2.63	1,662

A single glance at the tabulated results here presented shows that barley has given on the average a greater number of pounds of grain per acre per annum than any of the other six crops under experiment. The barley has surpassed the oats by an average of seventy-four pounds of grain per acre. Another interesting feature of the experiment is the fact that emmer, a species of wheat, has slightly surpassed the yield of oats in grain production. The emmer is a wheat which is used for feeding purposes, somewhat similar to oats and barley. When the grain is threshed the head simply breaks into spikelets and there is not a clear separation of the grain and the chaff. The chaff in the emmer, however, is lighter than the hull in the oats and occupies an intermediate position between the percentage of the hull of barley and that of oats. For feeding purposes emmer is considered to be about equal with barley. For fuller information regarding emmer the reader is referred to a later part of this report. The six-rowed barley surpassed the hulless barley by an average of 251 pounds of grain per acre per annum. The hulless barley, however, surpassed the spring wheat in average annual yield of grain per acre per annum by 443 pounds.

In comparison with the results obtained at Guelph it is interesting to study the relative yields of the different classes of farm crops throughout Ontario. There is probably no Province in Canada or any State in the American union which has a better statistical record in regard to crop production than has the Province of Ontario. This information has been collected systematically in each of the past thirty-three years. From a study of the reports of the Bureau of Industries for Ontario we find that the following figures represent the average number of pounds per acre of each of the principal cereal crops as grown in Ontario for a period of **thirty-three years**, the grains as here presented being arranged in the order of productiveness:

Barley	1,339 pounds	Field Beans	1,026 pounds
Fall Wheat	1,266 "	Buckwheat	989 "
Oats	1,214 "	Spring Wheat	960 "
Field Peas	1,152 "	Rye	918 "

The barley occupies highest place in yield of grain per acre in the results obtained through the medium of the Bureau of Industries for Ontario for a period of thirty-three years as well as those obtained in the experiments conducted at the Ontario Agricultural College. The comparative yields of the barley and oats throughout Ontario are even greater than those obtained at Guelph, as the barley out-yielded the oats by an average of 125 pounds per acre per annum for the thirty-three year period. The increased difference in yield throughout Ontario may be brought about partly from the fact that some farmers are apt to sow the barley on a little richer land than that on which they sow the oats. When we consider the comparative results of barley and oats, and consider the fact that barley produces more digestible nutrients per pound than oats, we have a comparison decidedly in favor of the barley as compared with oats in the production of digestible food constituents per acre. The results at the College and throughout Ontario are in practically the same order, except that in the provincial results field peas have surpassed spring wheat, while at the College the spring wheat surpassed field peas in the yield of grain per acre per annum by an average of 11 pounds.

ROTATION OF CROPS.

It is highly important that each person adopt on his own farm the rotation of crops which is likely to give the best results to meet the conditions of the farm and the requirements of the system of farming. While it is true that no one rotation is the best under all conditions, it is equally true that certain underlying principles should be used as much as possible in each rotation. The rotation should be so arranged that the crop of each year should not only be the suitable crop for that season, but would also in some way or other form a preparation for the crop of the following year. A crop such as corn, roots, or potatoes when carefully cultivated assists the following crop by the destruction of the weeds, and by liberating plant food. The grain crops should be sown in such a way that they not only furnish good results themselves but make good nurse crops for seeding with grasses, clovers, or alfalfa. The leguminous crops, such as the clovers and the alfalfa, not only furnish a large amount of nutritious food, but also improve the mechanical condition of the soil, and add to the land some of the free nitrogen of the atmosphere in the root residue, and thus improve the land for the crops following. Any person who has not given the subject of crop rotation his careful thought and attention has not lived up to his opportunities in making use of one of the best features in high crop production from an economical standpoint.

INCREASE IN FARM CROPS.

But few people realize the rapidity with which farm crops can be increased from small amounts of seed. There is great encouragement for the plant breeder, whether he be a scientific experimenter or a practical farmer, in realizing that if he can secure one single seed of high perfection that little seed can soon be employed so as to fill an exceedingly important place in the agriculture of the whole Province. In the spring of 1903 I planted an oat grain which produced a plant in the experimental grounds. The seeds obtained from this one plant were planted in the spring of 1904, and the oats obtained in that year were sown with the grain drill in a field in the spring of 1905. In the summer of that year upwards of one hundred bushels of oats were harvested. It will, therefore, be seen that we obtained over one hundred bushels of oats as the direct result of one seed in the third year.

In the first year that we distributed the O.A.C. No. 21 barley a farmer in Huron County received one pound and sowed it on a plot one rod wide by two rods long. As the direct result of this he obtained in the third year over nine hundred bushels of this barley, which he sold for seed purposes at \$1.50 per bushel. The



An excursion party of farmers examining Experimental plots.

thousands of acres of the O. A. C. No. 21 barley which are now grown in Ontario each year originated from a single seed which was planted at the College eleven years ago last spring.

In the spring of 1911 the O.A.C. No. 72 oats were distributed for the first time, and three hundred farmers received one pound each along with two other leading varieties for experimental purposes. A farmer and his son living north of Toronto each applied for the oat experiment, and these tests were conducted separately in 1911. After the tests were completed, and the results had been reported to the College, the father gave to the son the product of his one pound of O.A.C. No. 72 oats. In the spring of 1912, therefore, the son had the product of two pounds of the O.A.C. No. 72 oats, which he carefully sowed on his farm and from which he obtained upwards of ninety bushels. After being strongly urged he consented to sell to a neighbor about one hundred pounds, for which he received twenty-five dollars. He sowed the remainder of the oats in the spring of 1913 and harvested in that year upwards of 3,400 bushels, nearly all of which he sold at about \$2.25 per bushel.

The above references will show that there is a wonderful opportunity for careful and progressive farmers to secure small quantities of some of the very best varieties of farm crops, and by care produce a large amount of seed of good quality in a comparatively short time and to great advantage to themselves and to the country.

CONTINUOUS GROWING OF VARIETIES WITHOUT CHANGE OF SEED.

In certain localities in Ontario it is still considered necessary by some farmers to change the seed quite frequently from one soil to another. This question has been discussed and argued for many years. There are some strong advocates for a frequent change of seed, while other men are just as strong in advocating the continuous growing of varieties on the same farm for a number of years, and especially if they have choice varieties and take pains in the selection of seed from year to year. In connection with the experimental work at the College upwards of thirty varieties of farm crops have now been grown continuously from twenty to twenty-six years without any change of seed whatever, from one farm to another. These include a number of varieties of oats, six-rowed barley, two-rowed barley, hullless barley, winter wheat, common spring wheat, macaroni wheat and potatoes. The results are very interesting, and show in many instances that in recent years instead of a decrease there has been an actual increase in yield of grain per acre. With the exception of a couple of years in which the seasons were very unfavorable for crop production the varieties have nearly all given a higher average yield per acre during the latter part as compared with the earlier part of the experiment. The soil on which these varieties have been grown has changed but little in fertility, and no plant selection has been used in this particular test. A large number of practical farmers are realizing more and more the fact that in very many cases they are able to grow the same varieties for a considerable period of time without any change of seed, providing proper care is taken in growing varieties suitable for the soil, in the careful selection of the seed, and in the cultivation of the land. From experiments which have been conducted at Guelph during the last quarter of a century it seems quite possible to grow the same varieties for a considerable length of time without a change of seed when proper care is taken in the selection of the seed and in the growing of the crop.

The Canadian Seed Growers' Association bases its work largely on the fact that improvement can take place on the farm by a proper selection of seed from the best individual plants. Also, that the superior qualities of the newly bred varieties obtained from Experiment Stations can be maintained for many years by the method of selection recommended by the Association.

INCREASED PRODUCTION RESULTING FROM SUPERIOR VARIETIES.

So much has been done within recent years in studying and in testing different varieties and in the introduction of a few of the kinds which have given the best results that it might be interesting to briefly consider the influence of this work on the crop production of the Province. This influence has probably not been exerted to as great an extent in the past as it will be in the future. This is largely owing to the fact that it takes some time for a variety to become extensively grown throughout the country. Some of the best varieties have only recently been introduced, and are as yet only grown by a few of the most progressive farmers.

The greatest influence has probably been exerted in barley. Twenty-five years ago practically all the barley was the Common six-rowed variety. This was grad-

ually supplanted by the Mandscheuri barley, which we introduced in 1889, and distributed throughout Ontario for experimental work about five years later. From the small lots which were distributed for co-operative experiments the variety was increased until it became the most extensively grown barley in Ontario. In 1903 the O.A.C. No. 21 variety was started from a single seed. This barley gave excellent results at the College, and was distributed throughout Ontario for the first time seven years ago. Its increase has been exceedingly rapid, and it is now grown by hundreds of farmers throughout the Province. It is probably safe to say that fully 95 per cent. of all the barley grown in Ontario is of the Mandscheuri and the O.A.C. No. 21 varieties. In the average results for the past five years at the College the average yield of grain per acre per annum has been 59.1 bushels for the O.A.C. No. 21: 58.8 bushels for the Mandscheuri, and 45.3 bushels for the Common Six-rowed.

In the oat crop the introduction of new varieties has also exerted a considerable influence. Twenty-five years ago the Egyptian and the Black Tartarian varieties were extensively grown throughout the Province. These have been largely supplanted by the Banner and the Siberian. Each of the four varieties here referred to have been grown at the College continuously for twenty-five years. In the average results of the whole twenty-five year period the annual yield per acre for these four varieties has been as follows: Siberian, 87 bushels; American Banner, 83.5 bushels; Egyptian, 74.1 bushels, and Black Tartarian, 68.2 bushels. It now looks as if a new variety, which we call the O.A.C. No. 72, which was distributed in small lots in 1911 for the first time, is going to supplant largely all the other varieties. In average yield of grain per acre per annum for the past six years the O.A.C. No. 72 has given 91.4 bushels, and the American Banner, 68.4 bushels.

Twenty-five or thirty years ago the winter wheat was represented largely by the Early Red Clawson and the Surprise varieties. At the present time the Dawson's Golden Chaff is the most extensively grown variety in the Province. If we compare the average results of the Dawson's Golden Chaff and the Early Red Clawson for a period of nineteen years we find that the former has given an annual yield of 51.1, and the latter of 46.1 bushels per acre.

A number of other instances might also be mentioned. The Common Grey buckwheat has been largely supplanted by the Silver Hull and the Japanese varieties; the Canada Yellow Flint corn by the Compton's Early Yellow Flint, the Salzer's North Dakota White Flint, and the White Cap Yellow Dent varieties; the White Elephant and the Beauty of Hebron varieties of potatoes by the Rural New Yorker No. 2, and the Empire State varieties; the Common Long Red variety of mangels by the Yellow Leviathan and other Yellow Intermediate varieties; the White Belgian variety of carrots by the Short White Intermediate varieties, etc. The crop production in Ontario will undoubtedly be improved to a considerable extent by a few superior varieties which are being introduced, but which have not had time to exert much influence on the crop production of Ontario. Amongst the new varieties here referred to I draw particular attention to the O.A.C. No. 72 variety of late oats; the O.A.C. No. 3 variety of early oats; the Marquis spring wheat; the O.A.C. No. 61 rye; the Rough buckwheat; the Potter and Arthur varieties of peas; the Pearce's Improved Tree beans; the Davies' Warrior and the Extra Early Eureka varieties of potatoes; the Wisconsin No. 7 White Dent corn; the Japanese Panicle millet; the O.A.C. No. 81 soy beans; and the Ontario Variegated and the Grimm varieties of alfalfa.

It is interesting to study the progress of agriculture in Ontario as revealed through the average yield per acre of some of our principal farm crops. I remember

some fifteen years ago addressing a meeting in Eastern Ontario when Mr. D. M. Macpherson drew particular attention to the fact that the farms of Ontario were not producing as good results at that time as they had produced twelve or fifteen years previously. We are delighted that a great change in this respect has taken place. The Bureau of Industries for Ontario has collected statistics on crop production in each of the past thirty-three years. If we divide the last thirty-two years into two periods of sixteen years each we find that for the latter as compared with the former period there has been an actual increase in yield of grain per acre of some of our principal farm crops as follows: barley, 20 per cent.; fall wheat, 10 per cent.; and oats, 9 per cent. These averages in increase in yield per acre if applied to the average value of the crops of Ontario for the past ten years would mean an annual increase for the Province about as follows: Oats, \$3,267,836; barley, \$2,174,147; and fall wheat, \$1,414,244; making a total of \$6,856,227. This represents simply the annual market value of the increases of the three principal grain crops per acre when we compare the last sixteen years with the sixteen years previous.

There are at present too many varieties of farm crops grown in Ontario. If many of the inferior varieties were dropped entirely and only the few leading kinds used in cultivation there would be a higher average yield per acre, a better quality of product, more uniformity in sample, and material which would command higher prices. We have evidence which causes us to believe that farmers are realizing more than ever before the importance of securing and growing only those varieties which have reached the highest perfection. A study of the varieties entered in the Field Crops Competition of Ontario, and also at the leading exhibitions at Toronto, Ottawa and Guelph, during the past two or three years, show that the O.A.C. No. 21 barley and the O.A.C. No. 72 oats are used more extensively than any other varieties of these two classes of grain. Both of these grains are exceedingly popular and will probably be successful in driving many of the inferior varieties from the farms of Ontario. We have the earnest hope that the next sixteen years will show even greater annual increases in yield of crops per acre.

INFLUENCE OF SEED SELECTION.

Although the question of seed selection has been discussed to a great extent in past years it is surprising how little accurate information of definite experimental work has been conducted either by farmers themselves, or by the Agricultural Colleges and Experiment Stations which are making a careful study of practical and scientific problems. Quite extensive work has been conducted at our own Agricultural College with the object of ascertaining definite information regarding the influence of different selections of seed on the resulting crops.

In each of six years an experiment has been conducted in which both large and small-sized seeds of each of four varieties of oats have been planted at seven different distances apart. One of the objects of this experiment has been to endeavor to find out whether the maximum yield obtained from large plump seed would be different from the maximum yield obtained from small plump seed. From the results of the six years' test we find that the maximum yields from the large plump seed have been greater than the maximum yield from the small plump seed in about 90 per cent. of all the tests which have been made. When the results of this experiment are prepared for publication we believe that some excellent information on the subject will be obtainable.

In each of a number of years an experiment has been conducted in which heavy and light oats have been grown continuously in comparison with each other, and the results are instructive. The selections were made with the Joane variety of black oats and consisted of grains which were large, plump and black, grains which were light in weight and of a grayish color, and grains from which the hulls had been removed in threshing. The experiment has been repeated twenty-one years. The results for the past three years show that in average yield of grain per acre per annum the large plump seed produced 67.2 bushels; the light seed, 50.2 bushels; and the hulled seed, 61.4 bushels. The average yield of oats per acre per annum for the whole period of twenty-one years is 63.7 bushels for the large plump seed; 51.4 bushels for the light seed; and 60.8 bushels for the hulled seed. This seems to indicate that the careful selection of the large plump seed tended to increase the crop, and that the continuous selection of the light seed tended to decrease the crop in yield of grain per acre. In average weight per measured bushel of the crops produced from the different selections of seed for the whole period of twenty-one years we have 34 pounds for the grain obtained from the large plump oats; 27.8 pounds for the grain obtained from the light oats; and 33.8 pounds for the grain obtained from the hulled oats.

An interesting and valuable experiment has been carried on at the College in which different selections of seed of various classes of grain have been tested from three to nine years. For this experiment seed was taken each year from a general crop of grain grown either on the College farm or in the Experimental Department. It will be understood that whatever difference there is from the influence of the selection of seed that difference is attributed entirely to the careful selection of the seed for the separate years in which the tests were made. The results show the influence of one year's selection, and are, therefore, of special interest to the practical farmer. For the large plump seed none but well developed grains were selected; for the small plump sample the grains selected were of a uniform character; and for the shrunken sample none but shrunken grains were used, the last selection being made regardless of the size of the kernels. The sample of broken grain in the case of barley, and also of rye, contained nothing but grains which had been broken crosswise; split grain, in the case of winter wheat, contained nothing but grains which were broken lengthwise; and split seed, in the case of peas, contained peas which were split and not broken. The grain from which these selections were made was all threshed with a grain separator, and the splitting and the breaking of the grains were, therefore, done in the usual process of threshing. In the selection of large, plump seed, one-half pound was carefully weighed from each class of grain. The number of large, plump seeds of each kind of grain was then counted, and a corresponding number was taken of the medium sized grain, the small, plump grain and the shrunken grain. In the case of the broken or split grain, twice the number of the half kernels, as compared with the whole grains, were used. The different selections were carefully sown upon plots of similar size.

That one year's influence of grain selection on the resulting crop is very marked is clearly shown from the tabulated results of seed selection here presented. In every instance, the large, plump seed gave a greater yield of grain per acre than small plump, shrunken or broken seed. The results of the experiment in a selection of seed of spring rye are presented this year for the first time. This experiment was started in the spring of 1912, and was repeated in 1914 for the third time. From a practical standpoint it seems to be an excellent practice, not only to sow clean seed grain that will be free from weed seeds, but to have the cleaning so thoroughly done that none but the very best seed is secured. When

this practice is carried out an important step has been made towards the obtaining of high yields of grain of superior quality. It is not only important to secure varieties which are outstanding in superiority, but it is also important to use large, plump, sound, vital seed of each variety.

COMPARATIVE RESULTS FROM SEED SELECTION.

Selections.	Class of Grain.	Years the tests have been repeated.	Weight per measured bushel. (Pounds).	Average yield per acre per annum.	
				Tons of Straw.	Bushels of Grain by Weight.
Large seed	Oats	7	33.2	1.9	62.0
Medium-sized seed	Oats	7	32.2	1.8	54.1
Small seed	Oats	7	31.8	1.8	46.6
Large plump seed	Barley	6	49.5	1.5	53.8
Small plump seed	Barley	6	48.8	1.5	50.4
Shrunken seed	Barley	6	49.1	1.4	46.0
Broken seed	Barley	6	48.6	1.3	43.2
Large plump seed	Spring wheat ...	8	59.1	1.4	21.7
Small plump seed	Spring wheat ...	8	58.3	1.3	18.0
Shrunken seed	Spring wheat ...	8	56.9	1.2	16.7
Large plump seed	Winter wheat ...	6	59.4	2.6	46.9
Small plump seed	Winter wheat ...	6	59.2	2.2	40.4
Shrunken seed	Winter wheat ...	6	59.1	2.1	39.1
Split seed	Winter wheat ...	6	54.2	.6	9.3
Large seed	Peas	6	56.3	1.3	28.1
Small seed	Peas	6	56.3	1.1	23.0
Sound seed	Peas	9	58.1	1.4	29.2
Split seed	Peas	9	57.9	.6	10.2
Large seed	Spring rye	3	52.5	2.1	23.5
Medium-sized seed	Spring rye	3	53.1	2.1	22.6
Small seed	Spring rye	3	53.4	2.0	20.5
Broken seed	Spring rye	3	....	1.8	

IMPROVED VARIETIES BY MEANS OF SELECTION AND OF HYBRIDIZATION.

In discussing the results of seed selection we have been able to see clearly the importance of the farmer in making use of the very best seed possible for crop production. This work has had no direct bearing upon the securing of new varieties by means of selection of individual plants or by means of hybridization. The results mentioned under the last heading are of great value in showing that in ordinary farm practice it is advisable to clean the seed very thoroughly, so that none but the best is sown. For plant improvement work, however, from a scientific standpoint, it is necessary to go beyond the mere selection of seed and to make selections from individual plants, and where necessary to make use of cross-fertilization in order to produce new varieties which are likely to be more superior than the older kinds. The variety tests at the College have formed an excellent basis on which to work. During the past few years much stress has been placed upon the improvement of those varieties which have given the highest tests in the carefully conducted variety experiments. For the work in selection thousands of

plants of the same variety have been grown at equal distances apart so as to give an opportunity for a careful study of the individual plants. As the result of this work we are now growing a number of selected strains of much prominence. These will be referred to in detail in the future pages of this bulletin. The O.A.C. No. 21 barley, which was started in 1903 from a single plant selected from about ten thousand plants, is becoming thoroughly established in Ontario. The O.A.C. No. 72 variety of oats is now increasing very rapidly throughout Ontario, as was evident this winter when about thirty entries of the O.A.C. No. 72 oats were made in the Seed Department of the Provincial Winter Fair held at Guelph in the early part of this month. The O.A.C. No. 3 variety, one of the thinnest hulled oats which has ever been grown at the College, will take its place amongst the early oats of the Province. The O.A.C. No. 61 variety of spring rye has shown itself to be the largest yielder of all the spring ryes tested at the College. The O.A.C. No. 81 soy bean is one of the best grain producers of the different kinds of soy beans which will mature at Guelph. These and other examples which might be mentioned, show that the work in plant selection which has been conducted at the College is now bearing fruit throughout the Province. The influence of this work we believe will increase from year to year.

A large amount of work in cross-fertilization has also been carried out at the College within the past few years. The object has been to secure new varieties which would be more suitable for Ontario than even the best of the named varieties which have been obtained through extensive experimental work, and through selection of individual plants. We have a large number of cross-bred varieties of nearly all classes of grain crops, and some of these are particularly promising, especially in certain characteristics.

CO-OPERATIVE EXPERIMENTS IN AGRICULTURE.

A large amount of co-operative experimental work is carried on by farmers of the Province through the medium of the Ontario Agricultural and Experimental Union. This is probably the most extensive and most complete system of experimental work amongst the farmers which can be found in any country. The present system was started in 1886, and has been carried on continuously in each of the past twenty-nine years. In 1914, co-operative work was conducted on farms throughout Ontario in agriculture, agricultural chemistry, agricultural botany, bee-keeping, forestry, and in connection with the Public Schools in elementary agriculture, horticulture and forestry. The development of this work can be understood to a certain extent through a knowledge of the increase in the number of experiments in agriculture for the past twenty-nine years. The following figures give the average annual number of farmers who have been acting as experimenters on their own farms, the results being presented in periods of four and five years each:

Periods.	Years.	Average Number of Experimenters per annum.
1886-1890	5	71
1891-1895	5	1,060
1896-1900	5	2,992
1901-1905	5	3,379
1906-1910	5	4,278
1911-1914	4	4,519

The number of experimenters per annum in each of the six periods here referred to varied in each period as follows: 1st, 12 to 125; 2nd, 203 to 1,699; 3rd, 2,360 to 3,485; 4th, 2,760 to 4,050; 5th, 3,617 to 4,856; and 6th, 4,166 to 5,027. It will, therefore, be seen that this work has become very comprehensive. It is impossible to estimate the great good which has been brought about in various ways through the medium of the co-operative experimental work. The principal conclusions from the carefully conducted experiments carried on throughout the Province are presented and discussed each year at the annual meeting of the Experimental Union. The proceedings of the annual meeting, with the results of the co-operative experiments, are printed in the annual report of about one hundred pages, and some 30,000 copies are issued. Interested readers who have not received the last annual report, and who desire to study the results of the co-operative experiments, should apply for a copy of the annual report of the Ontario Agricultural and Experimental Union to the Department of Agriculture, Parliament Buildings, Toronto.

LOOSE SMUT IN OATS, AND STINKING SMUT IN WHEAT.

Various investigations have been conducted in the scientific departments of Experiment Stations in a study of the best methods for treating the various smuts which occur in grain crops. As the result of these investigations certain recommendations have been made by different institutions. The Experimental Department at Guelph has made very careful tests in studying the practical application of some of the most highly recommended treatments for the destruction of the different kinds of smut. The results of these practical tests are of great value to the men actually engaged in the growing of grain crops in the Province of Ontario. We, therefore, present this information with the hope that it may exert a marked influence in largely preventing the ravages of these very troublesome fungus pests.

The spores of the smuts correspond with the seeds of the grains, and germinate and grow when the conditions of heat, moisture, and food become favorable. The smuts are fungus plants which enter the tissues of other plants, such as those of wheat, oats, barley and corn, where they live and grow, and finally produce smut spores. The reproductive organisms of the loose smut of wheat and the loose smut of barley may exist in the tissues of the ripened grains, and it is, therefore, difficult to kill these two smuts, and also to retain the vitality of the wheat and the barley. Although the hot water treatment may be effectual in killing these smuts, it is rather difficult to carry out satisfactorily in ordinary farm practice. It is important to secure seed wheat and seed barley from farms which are not infested with the loose smut of these grains. There is no effectual method known for preventing the smut of corn by a simple treatment of the seed, as the disease may attack any part of the tender growing plants at any time. The smut masses of corn should be gathered and burned and the spores thus prevented from being scattered on the land or embodied in the manure. The spores of the loose smut of oats and of the stinking smut of wheat which attach themselves on the outer surfaces of the ripened grains can be readily killed by treatment. This fact is of great agricultural and economic importance. The information here presented should prove of much value in showing by actual experimental evidence that the loose smut of oats and the stinking smut of wheat can be completely and satisfactorily destroyed, and that the crops entirely free from these diseases can be procured. If farmers grow wheat and oats which are infested with these smuts, they have themselves to blame. With a little care they can keep their farms prac-

tically free from these two pests which have frequently caused heavy losses in past years.

For five years in succession experiments have been conducted at the Ontario Agricultural College for the prevention of the loose smut in oats and of the stinking smut of wheat. Careful determinations were made each year to ascertain the comparative influence of different treatments. There were in all, seven treatments for oats, and five for wheat. In every instance, one sample was left untreated as a basis of comparison. An experiment was conducted in duplicate with oats, and also with wheat each year, there being two varieties of each class of grain used for the experiment. The seed grain was obtained each year from a known source, and where no treatment for smut had been attempted for several years previously. The following treatments were used throughout, with the exception of numbers 3 and 6, which were omitted from the treatments for the stinking smut in wheat.

(1) *Untreated.* One sample of oats and one sample of winter wheat of each variety were left untreated, in order that the influence of the various treatments might be better observed.

(2) *Immersion in Hot Water.* The grain was placed in a bag and immersed in water at about 115 degrees F. Soon afterwards it was placed in water which was kept at a temperature of between 130 degrees and 135 degrees F. The grain was occasionally stirred and was allowed to remain in the water for a period of fifteen minutes. It was then spread out on a clean floor to dry, where it was stirred occasionally.

(3) *Immersion in Bluestone Solution for Five Minutes.* A strong solution was made by dissolving one pound of copper sulphate (bluestone) in one gallon of water, and the oats were immersed in the solution for a period of five minutes.

(4) *Immersion in Bluestone Solution for Twelve Hours.* The bluestone solution was made by dissolving one pound of bluestone in twenty-five gallons of water, and the grain was immersed in this solution for a period of twelve hours.

(5) *Sprinkling with Bluestone Solution.* The solution was made by dissolving one pound of bluestone in ten gallons of water, which was used for sprinkling over the grain until it was thoroughly moistened after being carefully stirred.

(6) *Immersion in Potassium Sulphide Solution.* The potassium sulphide treatment consisted of soaking the oats for two hours in a solution made by dissolving eight pounds of potassium sulphide in fifty gallons of water.

(7) *Immersion in Diluted Formalin.* The solution of formalin (40 per cent. formaldehyde) used for the immersion process with oats and with wheat was made by pouring one-half pint of the formalin into twenty-one gallons of water, and the grain was immersed in this solution for a period of twenty minutes, during which time it was stirred occasionally.

(8) *Sprinkling with Diluted Formalin.* One-half pint of formalin was poured into five gallons of water and the grain was sprinkled with this solution and stirred until it was thoroughly moistened.

After the treatments had been made for a few hours, and the grain had become sufficiently dried, it was carefully sown on separate plots. When the winter wheat was about ready to cut, it was carefully examined and the heads containing stinking smut were gathered and shelled. The rest of the crop was then threshed and again examined for any smut balls from heads which had been missed in the standing crop. When the oats were coming into head they were examined fre-

quently and all smutted heads were removed and carefully counted. The accompanying tables give the average results in percentage of grains of winter wheat affected with stinking smut and of the heads of oats affected with loose smut in each of the five years during which each experiment was conducted. Besides this information, the average yield of oats per acre for the five years and the average yield of winter wheat per acre for three years are included.

RESULTS OF EXPERIMENTS TO KILL THE LOOSE SMUT OF OATS.

Materials.	Percentage of Smut.						Average yield of grain per acre 5 years. (Bus.)
	1st year test.	2nd year test.	3rd year test.	4th year test.	5th year test.	Average 5 years.	
1. Untreated	5.5	3.9	11.6	4.3	3.4	5.7	60.3
2. Hot water	.0	.0	.0	.1	.0	.0	63.7
3. Bluestone—5 minutes	1.7	.9	.7	.6	.1	.8	59.5
4. Bluestone—12 hours	.6	.0	.0	.1	.0	.1	56.0
5. Bluestone—sprinkled	.9	2.0	1.4	.6	1.6	1.3	61.8
6. Potassium Sulphide	3.4	.1	.3	1.5	.7	1.2	66.2
7. Formalin—Immersed	.0	.0	.0	.0	.0	.0	68.3
8. Formalin—Sprinkled	.0	.1	.0	.0	.0	.0	61.3

RESULTS OF EXPERIMENTS TO KILL THE STINKING SMUT OF WHEAT.

Materials.	Percentage of Smut.						Average yield of grain per acre 8 years. (Bus.)
	1st year test.	2nd year test.	3rd year test.	4th year test.	5th year test.	Average 5 years.	
1. Untreated	3.6	9.3	.6	.6	6.8	4.2	38.0
2. Hot water	.0	.0	.0	.0	.0	.0	40.6
4. Bluestone—12 hours	.0	.0	.0	.0	.0	.0	40.2
5. Bluestone—sprinkled	.0	.2	.0	.0	.1	.1	41.1
7. Formalin—Immersed	.0	.0	.0	.0	.0	.0	43.3
8. Formalin—Sprinkled	.0	.0	.0	.0	.0	.0	36.3

The results show that the greatest yields of both winter wheat and oats per acre were produced from the grain which was immersed for twenty minutes in a solution made by adding one-half pint of formalin to twenty-one gallons of water. They also show that this treatment was effectual in completely killing the smut. Of the different bluestone treatments for smut in oats the most effectual was No. 4, but even that was not as satisfactory as the treatment in which the oats were placed in the formalin solution. It will be observed that No. 3 and No. 4 treatments with oats apparently injured the germination of the seed slightly, and consequently lowered the yield of grain per acre. It will also be noticed that the sprinkling with the formalin solution reduced the yield of winter wheat, the average being nearly two bushels per acre less from the treated than from the untreated seed.

The formalin which was used in the experiments was the same as a 40 per cent. formaldehyde solution. The material is a clear liquid, which can be purchased from almost any druggist, and the prices range from thirty to fifty cents per pint. When purchased in larger quantities, and especially from the manufac-

turers, the cost is much less proportionately. It can be purchased either under the name of formalin or of formaldehyde, but when under the latter name it should always be mentioned that it is the 40 per cent. solution which is required. One pint of formalin should be sufficient for treating from ten to twenty bushels of grain as several treatments may be made with the same solution, each lot of grain requiring to be immersed for twenty minutes. If the treatment is done in a barrel the grain could be placed in a bag made of very coarse material, the bag being about three-quarters filled with grain. After the treatment is made the grain should be spread thinly on a floor or on canvas, where it can be stirred, and allowed to dry sufficiently to be sown. The sooner it is sown after treatment the better. If the damp grain is placed in bags, in the drill, or in any closed place for a few hours there is danger of the vitality of the seed becoming weakened. We treat, on an average, about one hundred bushels of wheat and oats at the College each spring, and have always met with success when using the immersion treatment with the formalin solution as here described. The treatment is easily applied, and is comparatively cheap. It is effectual in completely killing the loose smut of oats and the stinking smut of wheat, and in producing the largest average yields of the grains per acre of all the treatments used.

SMUT RESISTANCE IN OATS.

Until recently there appeared to be little knowledge regarding the difference in smut resistance in various kinds of oats. An examination of different varieties showed that some kinds possessed smut to a much greater extent than other sorts. As the result of this observation a careful study has been made of a few of the varieties of oats in order to glean fuller information on this important question.

RESULTS OF OATS TREATED FOR SMUT IN THE SPRING OF 1906.

Variety.	Number of Smutted Heads Per Plot.										
	Before Treatment.				After Treatment.						
	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912
Early Ripe	0	0	3	0	0	0	0	0	0	0	2
Joanette	20	9	10	18	0	2	12	1	0	0	0
Siberian	32	43	78	20	0	1	0	0	5	0	1
American Banner	116	303	317	22	0	3	2	4	5	0	6
Black Tartarian	332	608	369	62	0	3	12	15	29	25	44

Only once during the thirteen-year period were these oats treated so as to destroy the smut spores. The treatment used was by immersing the oats for twenty minutes in a solution made by mixing one-half pint of formalin into twenty-one gallons of water. This treatment took place in the spring of 1906. The results show how very effectual was the treatment, and that if a treatment is carefully done it lessens the amount of smut for many years without further treatment, providing care is exercised in the handling of the crop. It is difficult, however, to take sufficient care so as to prevent a small amount of smut appearing in the grain from year to year. The results presented in the foregoing table show that the Early Ripe appears to be almost immune to the attacks of smut, there being only three heads in 1904, one head in 1913, and two heads in 1914. As these oats are grown in land which has a four years' rotation, and which is manured once during

that rotation, there is a possibility of there being a slight mixture of oats, and it is possible that these few heads which have appeared might be from a little mixture of some other variety. In comparison with the Early Rippe it will be seen that the Black Tartarian is extremely susceptible to the attacks of smut. The high number of smutted heads show both in the favorable and in the unfavorable years, and both before and after the grain is treated. The results seem to indicate very strongly that there is a great difference in the varieties of oats regarding their susceptibility to the attacks of smut.

AMOUNT OF OATS TO SOW PER ACRE.

The question of the amount of seed of the cereal grains to be sown for the best results has been discussed many times and in many places. Experiments have been conducted with the object of securing information on this problem in different countries, and yet we have reached no unanimity in regard to the matter. We find, for instance, in Canada, that the amount of oats which is sown per acre will vary from one to four bushels, and in Scotland the quantity frequently reaches six bushels of seed per acre. We find very strong advocates of using as small a quantity as one bushel of oats, while others will argue as earnestly for the advisability of using as high as six bushels or more per acre. The question then arises as to why there is such a difference in the views of men who have had wide experience in the growing of grain upon their individual farms. I think we are safe in coming to the conclusion that these variations are caused partly on account of knowledge, and partly on account of ignorance. It is undoubtedly true that the amount of seed per acre which would give the highest results under certain circumstances would not give the highest results under other conditions. There are many factors which exert an influence in determining the quantity of seed to use to give the best returns, each of these factors producing its own particular influence. The fertility of the soil, the state of cultivation, the moisture content of the soil, the variety of the crop, the method of seeding, the date of seeding, and many other factors apparently exert their respective influence in regard to the amount of seed to be sown in order to secure the highest returns. If this be true, it can readily be seen that we cannot come to a definite conclusion regarding the quantity of seed to use per acre of any class of farm crops which would give the highest returns under all circumstances. Nevertheless, it must be admitted that definite knowledge regarding the influence of some of the factors above referred to is very meagre, indeed. We believe that as knowledge along these lines accumulates we shall be in a very much better position to know what is likely to give satisfactory results under the varying conditions in which a crop is to be grown. We believe, therefore, that any new and definite information obtainable which will throw additional light on this problem will be appreciated.

To glean information in regard to the influence of the stooling of oats, the influence of large and small seed, and the influence of different quantities of seed per acre, an experiment has now been conducted at the College for five years in succession. Both large and small seed of each of four varieties in each of six years were planted in squares, one, two, three, four, six, eight and twelve inches apart. The seed was planted by hand, and with very great care. Each plot was surrounded by oats of the same kind, and planted in the same way. When the crops were ready to harvest the surrounding plants were removed so that the crops under experiment would not be influenced by the paths surrounding the plots. Each plot was harvested with great care, and the weight of the total crop was determined, and after threshing was completed the amount of grain was subtracted

for the entire crop, thus furnishing the combined weight of straw and chaff. The results of this experiment for more than four years have not as yet been prepared for publication. The average results from the four varieties planted for the four-year period give the following yields of grain per acre per annum from the different distances apart of planting as follows: one inch, 30.6 bushels; two inches, 35 bushels; three inches, 41.7 bushels; four inches, 39 bushels; six inches, 37.3 bushels; eight inches, 31.8 bushel; and twelve inches, 31.9 bushels. It will be seen that the highest yield per acre was obtained from planting the seeds three inches apart both ways. This required 46.1 pounds, or 1.36 bushels of seed per acre. It is quite possible that a little thicker or a little thinner seeding might have produced a somewhat higher yield. It is interesting to note, however, that the oats which were planted two inches apart each way, and which required slightly over three bushels per acre, gave an average of only 35 bushels of crop, or more than six bushels per acre less than was obtained from the lighter seeding. In the near future we expect to present the results of this, and other experiments which we have under way in a more detailed manner. When this material is submitted we believe it will add a considerable amount of valuable information in regard to both the selection of seed and the stooling properties of oats as they relate to crop production, in addition to the information furnished in regard to the thickness of seeding of this most important crop.

GRAINS GROWN IN COMBINATIONS FOR GRAIN PRODUCTION.

In the past twenty years a large number of experiments have been conducted at the College in growing different classes and different varieties of grain in combination for the production of green fodder, of hay, and of grain. Many valuable results have been obtained. A number of these have already been presented in annual reports of past years and other experiments are now under way. It is interesting to know that in 1914 there were 456,631 acres devoted to the growing of mixed grains in Ontario. The results of experiments show that for green fodder and for hay a mixture of two bushels of oats, such as the Siberian or the Banner varieties, and one bushel of peas, such as the Prussian Blue or the Golden Vine varieties, makes an admirable mixture for growing in combination. For grain production, one bushel of the Daubeney oats combined with one bushel of the O.A.C. No. 21 barley have given excellent satisfaction as a farm crop. It is quite probable that the O.A.C. No. 3 oats will soon take the place of the Daubeney variety. The results of our experiments have shown that a combination of the best variety of oats and the best variety of barley grown together will produce on an average fully two hundred pounds more per acre than either one when grown alone. The experiments which have been conducted in the past at the College seem to indicate that there is but little advantage from growing in combination two different varieties of the same class of grain, but there are often marked advantages from growing suitable varieties of different classes of grain together.

VARIETIES OF SPRING BARLEY.

Nineteen hundred and fourteen was a comparatively good year for barley production in Ontario, the average yield per acre throughout the Province being 31.2 bushels, in comparison with 29.3 for 1913, and 27.9 for the average of the past thirty-three years, as furnished in the November bulletin of the Ontario Bureau of Agriculture. The only small grains which are grown more extensively than barley in Ontario are oats and fall wheat. The yield of barley in the Province in 1914 amounted to 18,096,754 bushels. The barley crop is, therefore, exceedingly

important in connection with the agriculture of the Province. The yield of barley in Ontario has been considerably increased in recent as compared with former years, and this increase has undoubtedly been brought about largely by the introduction of two new varieties, viz., the Mandscheuri, which the College imported from Russia in the spring of 1889, and the O.A.C. No. 21, which was started from a single seed at the College in 1903.

Barley, as grown in the Experimental Department at Guelph, can be divided into three distinct classes, viz., the six-rowed, the two-rowed and the hulless. These three classes differ from each other in several respects. As a rule the six-rowed barleys are early in maturing and give comparatively large yields of grain per acre. The two-rowed barleys differ from the six-rowed barleys, not only in the nature of the head, but they are as a rule later in reaching maturity, and are somewhat lower in grain production, although the grain in some instances weighs more per measured bushel than that of the six-rowed varieties. The hulless barleys have a standard weight per measured bushel of 60, instead of 48 pounds. The straw is usually short and somewhat inclined to lodge.

RESULTS OF TWENTY-ONE DIFFERENT VARIETIES OF BARLEY.

Classes and Varieties.	Bearded or Bald.	Color of Grain.	Average Height.	Per Cent of Rust.	Days to Reach Maturity.	Weight per Measured Bushel.	Yield Per Acre 5 Years.	
							Straw.	Grain.
			(Ins.)			(Lbs.)	(Tons.)	(Bus.)
Six-rowed:								
O.A.C. No. 21	Bearded..	White..	36	3	100	49.09	1.68	59.12
Mandscheuri	Bearded..	White..	35	3	100	48.26	1.67	58.60
California Brewing	Bearded..	White..	27	4	102	47.42	1.45	58.77
Zulu King	Bearded..	Black..	26	6	98	48.92	1.48	54.94
Oderbrucker	Bearded..	White..	34	3	99	48.82	1.57	53.40
Oregon	Bearded..	White..	27	6	110	47.99	1.68	48.85
Mensury	Bearded..	White..	31	4	97	51.07	1.51	47.40
Common Six-rowed	Bearded..	White..	33	4	98	49.88	1.51	45.34
Success	Bald	White..	33	6	93	47.08	1.31	40.67
Two-rowed:								
Hanna No. 5590 (Iowa)	Bearded..	White..	31	3	104	53.49	1.66	52.05
Two-rowed King	Bearded..	White..	30	3	105	52.57	1.66	51.83
Imported No. 5591 (Iowa)	Bearded..	White..	30	4	104	52.74	1.67	50.33
Jarman's Sel't'd Beardless	Bearded..	White..	29	4	106	53.06	1.53	48.20
French Chevalier	Bearded..	White..	29	4	109	51.71	1.73	42.92
Duckbill	Bearded..	White..	30	9	108	50.45	1.71	41.01
Two-rowed Canadian	Bearded..	White..	29	8	108	51.01	1.65	40.27
Hulless:								
Guy Mayle	Bearded..	Green..	27	4	95	60.13	1.58	46.29
Black Hulless	Bearded..	Black..	29	4	99	62.13	1.59	46.16
Winnipeg No. 2	Bearded..	White..	27	3	99	58.85	1.77	43.50
Purple	Bearded..	Purple..	27	3	99	62.35	1.56	42.79
New White Hulless	Bald	White..	27	6	104	60.16	1.73	32.80

Of the nine six-rowed varieties of barley which have been grown under competition in each of the past five years it will be seen that there was a difference in the average annual yield per acre of nearly twenty bushels. In the spring of 1903 selected grains of the Mandscheuri barley were planted by hand at equal distances apart in the Experimental Department at the College. These grains numbered between nine and ten thousand. This method gave an opportunity for each plant

to show its individuality. When the plants were ripe they were carefully examined and thirty-three of the most promising ones were selected, harvested and threshed separately. In 1904 these lots were sown separately in rows, and these rows were carefully examined and the most important ones were harvested and threshed. From that time forward only the best strains were grown in the test, as follows: 14 in 1905; 8 in 1906; 7 in 1907; and 3 in each of the past seven years. During the first year the different strains were known by separate numbers, and the one which has proved to be the best is what is known as the O.A.C. No. 21. This barley possesses a good length of straw which is particularly strong in comparison with most other varieties. The heads possess six rows of grain and are bearded. The grain is white on the outside, but is of a bluish color immediately under the hull. So far the crop has been comparatively free from rust. The weight of the grain per measured bushel has been somewhat over the standard, and the yield per acre has been heavy. In each of the past four years the O.A.C. No. 21 has surpassed the Mandscheuri in yield of grain per acre. In 1910, however, the O.A.C. No. 21 was surpassed by the Mandscheuri, owing apparently to the fact that a



O.A.C. No. 21 Barley.

part of the land on which the O.A.C. No. 21 was grown was a little low, on which water stood for a time, which caused a reduction in the yield of grain. In spite of this fact, however, the O.A.C. No. 21 has given a higher average yield of grain per acre than the Mandscheuri variety in the five-year test. The O.A.C. No. 21 was distributed throughout Ontario in connection with the Experimental Union about seven years ago for the first time, and it has made a very excellent record. In each of four years in which it was compared with the Mandscheuri in the co-operative experiments throughout the Province it surpassed the latter in yield of grain per acre, in freedom from rust, and in both length and strength of straw. From the one pound lots of the O.A.C. No. 21 barley which have been distributed through the medium of the Ontario Agricultural and Experimental Union this variety has increased very rapidly over the Province. In each of the past four years it has proven the most prominent variety in the competition of fields of standing grain in Ontario, and in connection with our largest exhibitions with threshed grain. At the Provincial Winter Fair held in Guelph in the early part of the present month all entries of barley in the field competition class were of the O.A.C. No. 21 variety. A knowledge of the history of barley growing in

Ontario as influenced by the Ontario Agricultural College, furnishes even from a financial standpoint a strong argument for the existence of the College. The entire cost of the College has been far more than paid back to the Province by the increase in the barley crop as the direct result of the improvement in yield of barley through the distribution of better varieties obtained at the College through importation and through selection. It is now estimated that about 96 per cent. of all the barley which is grown in the Province belongs to the Mandscheuri or to the O.A.C. No. 21 varieties. The increase in the yield per acre of barley in Ontario for the last sixteen years as compared with the sixteen years previous would amount to about 35,000,000 dollars, or sufficient to maintain the Ontario Agricultural College at its present cost of maintenance for approximately one hundred and ninety (190) years.

For nineteen years in succession the Mandscheuri barley was distributed throughout Ontario for co-operative experiments. In every year this variety was compared with one or two leading varieties and the results were decidedly favorable to the Mandscheuri variety. From these lots so distributed the barley was increased over Ontario until it became very generally known. It was undoubtedly the most popular variety grown in Ontario until the introduction of the O.A.C. No. 21, which is taking the place of all other kinds, supplanting even the Mandscheuri variety.

In each of the past twenty-five years each of four varieties of six-rowed barley has been grown at the College. The following table gives the yield per acre of each of these varieties of barley for 1890, which is the first year in which they were grown, and also the average yield for the twenty-five year period:

Varieties.	Yield per Acre, 1890.	Average yield per acre 25 years.
	Bush.	Bush.
Mandscheuri	51.9	69.3
Oderbrucker	47.2	62.7
Common Six-rowed	41.7	59.2
Mensury	38.8	57.7

The results show that the average yield per acre for the twenty-five year period was considerably higher than the yield for the first year in which these varieties were grown. The highest yields per acre were produced in 1899, 1904, and in 1910. The detailed results show us that barley can be grown on the same farm for a long period of time without change of seed and without deterioration of the crop, providing care is taken in the selection of the seed and in the growing of the crop.

VARIETIES OF WINTER BARLEY.

In each of seven years two varieties of winter barley have been under test at the College. The average results of the seven years' experiment show that the Tennessee winter barley gave an average of 41.8, and that of the Wood's winter barley 41.5 bushels of grain per acre. In 1914 the Tennessee winter barley gave 40.6 bushels and in 1913, 51.7 bushels per acre. As one variety of winter barley has now been grown at the College in each of eighteen years the results are very interesting. The average annual yield per acre for the whole period was 47.9 bushels of grain, and 1.2 tons of straw. The average weight per measured bushel

was 50.6 pounds. Winter barley is somewhat less hardy than winter wheat in Ontario.

VARIETIES OF OATS.

There are about four times as many acres used for growing oats in Ontario annually as for any other grain crop. In 1914, no less than 2,776,883 acres of oats were grown in the Province. With the exception of 1907 this was the greatest acreage of oats ever produced in Ontario. In 1914 the average yield per acre of oats in the Province was 37.3 bushels. This is 1.6 bushels per acre higher than the average for the past thirty-three years, and has been surpassed only eleven times in the thirty-three year period. It will, therefore, be seen that the oat crop is an exceedingly important one, reaching approximately 40,000,000 dollars in the present year. The reader is requested to study the results of the varieties presented in this report, and apply the comparative results to the Province of Ontario; he would then realize something of the great influence which is gradually being



Field of O.A.C. No. 72 Oats.

exerted through the introduction and the general cultivation of oats of the highest perfection in yield and in quality. We believe that the O.A.C. No. 72 variety of oats, originated at this College, and distributed in 1911 for the first time, will be worth millions of dollars to the Province of Ontario.

Fully three hundred varieties of oats have been carefully tested in the experimental grounds at the College, but many of these have been dropped after they have been grown for five years in succession, owing to the fact that other varieties have proven more successful. Each year a few new varieties are added, and a few of the inferior ones are dropped. In 1914, one hundred and six varieties, selections and hybrids were grown in competition in the experimental grounds. Of this number nine varieties have been grown continuously for twenty-five years, thirty-three varieties continuously for five years, and the remainder are either selections or hybrids or have been grown for less than five years. The following gives the average yield of grain of nine varieties grown continuously for twenty-five years:

Varieties.	Yield per Acre.	Varieties.	Yield per Acre.
	Bush.		Bush.
Siberian	87.0	Oderbrucker	82.7
Joanette	84.3	Bavarian	80.3
American Banner	83.5	Egyptian	74.1
Probsteler	83.2	Black Tartarian	68.2
Waterloo	83.0		

The results here presented show that there is an average difference of 18.8 bushels per acre between the highest and the lowest yields of the nine varieties of oats grown under similar conditions in each of the twenty-five years from 1890 to 1914 inclusive. The American Banner oats, which have been grown so extensively over Ontario, have been surpassed by the Siberian variety by an average of 3.5 bushels per acre. The Black Tartarian and the Egyptian varieties which come at the bottom of the list were two of the most commonly grown varieties in Ontario twenty-five years ago.

RESULTS OF DIFFERENT VARIETIES OF OATS TESTED CONTINUOUSLY FOR FIVE YEARS.

Varieties of Oats.	Average Result for Five Years.						Yield of Grain per Acre.	
	Per cent. Hull, five years.	Hulls, name or Spreading.	Days to Mature	Height.	Per cent. Rust.	Weight per Measured Bushel.	Straw per Acre.	1914.
				Ins.		lbs.	tons.	Average Five Years.
Yellow Sixty-day	28.9	S	102	40	7	33.03	1.86	81.26
Sixty-day White	29.1	S	109	42	15	34.07	2.04	73.18
Yellow Kherson	26.7	S	102	36	4	32.41	1.61	73.38
Iowa Silver Mine	28.9	S	109	42	14	33.62	2.00	70.59
Kherson White	28.6	S	109	42	13	34.40	2.04	75.68
Siberian	29.2	S	109	40	7	33.14	1.74	78.41
Prosperity	28.5	S	109	42	14	33.97	1.97	72.65
Abundance	28.1	S	109	41	14	34.66	1.86	75.26
New Sensation	27.6	S	110	41	14	34.86	1.95	70.26
Alaska	27.6	S	106	41	11	34.85	1.86	69.18
Probsteler	28.3	S	109	40	11	33.50	1.82	75.91
Pioneer	35.9	S	108	38	15	32.50	2.20	76.79
Great Dane (No. 12 Gunson)	28.7	S	113	38	14	31.99	2.01	79.50
Ligowa	28.1	S	109	40	13	34.27	1.85	82.69
Oderbrucker	30.3	S	110	41	14	33.00	2.21	74.82
Waterloo	27.7	S	111	40	13	31.62	2.08	85.71
Liberty	29.3	S	112	39	13	33.05	1.82	79.09
Bavarian	28.0	S	111	39	11	32.96	2.16	81.56
Joanette	23.8	S	106	36	7	33.16	2.05	64.35
Burt	26.6	S	100	39	8	26.29	1.67	59.41
Yellow Russian No. 101	29.3	S	102	39	12	33.50	1.70	82.62
Early White Cluster	27.8	S	109	39	13	34.13	1.86	86.12
Tartar King	32.9	M	108	43	12	34.87	1.86	64.47
White Wave	27.6	S	109	38	14	34.08	1.73	82.79
Egyptian	31.3	M	110	42	15	34.70	2.20	68.79
Vick's American Banner	31.3	S	111	39	9	33.19	1.76	83.76
Early Ripe	25.6	S	100	38	6	33.03	1.62	63.85
Daubeney	25.2	S	102	38	6	35.29	1.59	63.88
Early Dawson	33.8	S	104	45	13	37.67	2.08	61.50
Storm King	33.4	M	108	39	16	33.54	1.90	68.74
White Superior Scotch	34.3	S	104	45	14	38.11	1.99	57.21
Black Tartarian	31.0	M	115	39	21	29.62	2.00	70.76
Hullless Oats		S	109	43	8	44.11	2.48	44.29

As already mentioned the great majority of varieties after being tested at the College for a period of five years have been dropped from the list. We, therefore, have in the present list, which is a comparatively short one, all those varieties which have made the highest record out of some three hundred which have been tested. Even in the results here presented, however, it will be seen that there is a very marked difference in yield of grain per acre. The Black Tartarian has given approximately forty bushels per acre per annum less than the Yellow Sixty-Day variety. The Vick's American Banner, although surpassing the Black Tartarian by an average of about 13 bushels per acre per annum, has been surpassed by at least ten varieties by fully 13 bushels per acre per annum. It is interesting to note that out of the five highest yielding oats four of them are either the Sixty-Day or the Kherson strains. These two varieties, which are quite similar in their various characteristics, have been carefully selected at the College, and each of these selections have made a high record. The White selections which were taken from the Yellow oats vary somewhat in earliness as in each case the White oats are a week later than the Yellow. Outside of the earliness of the crop the characteristics of the White strains resemble quite closely those of the Yellow varieties. It will be seen, however, that in both cases the Yellow oats have surpassed the White ones in yield per acre. Probably the three greatest weaknesses of the Yellow Kherson and the Yellow Sixty-Day varieties of oats are the yellow color of the grain, the light weight of grain per measured bushel, and the small yield of straw. The Yellow Kherson is the fourth lowest in weight per measured bushel, and is the second lowest in yield of straw of all the varieties on the list. Both the White and the Yellow Sixty-Day and the Kherson have been carefully selected at the College, and it is practically impossible to get these varieties with a high yield and quality through the seed trade or through commerce. The Yellow Kherson has been used in the co-operative tests of the Experimental Union in Ontario, but with only fair results.

Oats form an exceedingly interesting and important grain for study. There are some wrong conceptions in regard to the real value of oats in Ontario. The best variety for the farmer to grow on his farm is not necessarily the variety which takes the highest prize in the Field Crop Competition, nor the variety which makes the highest record in the exhibit of threshed grain, nor yet the variety which occupies the highest place in both of these competitions. In order to find out the real value of an oat it is necessary to grow the different varieties under similar conditions, and to make a definite comparison of all the important characteristics. It is interesting to note that some of the varieties which stand the highest in both yield and quality of grain are not varieties which make a particularly good showing in the field or at the Exhibition. To back up this statement, I would invite a careful study of the varieties presented in the foregoing table, and then a careful consideration of the varieties which have in the past been used prominently in various competitions. According to our own investigations which extend over many years we have found that as a rule those varieties of oats which weigh the most per measured bushel are light yielders and of poor quality. The reader should make a careful study of the results presented in the accompanying table and see if the statement will not prove to be correct. It will be seen that each of the ten highest yielding varieties of oats possess grain which has less than 30 per cent. of hull, while each of the ten lowest yielding varieties include seven varieties which possess grain with the hull varying from 31 to 34.3 per cent. It will also be observed that of the ten highest yielding varieties only five have produced grain which, in the average of the last five years, has weighed upwards of the

standard of thirty-four pounds per measured bushel, while of the ten lowest yielding varieties six kinds are over the standard in weight, and of these six two have given an average of over 37 pounds per measured bushel. Attention is also drawn to the fact that the four varieties of mane or side oats are all included in the twelve lowest yielding varieties. We have never yet found a particularly high yielding mane oat. The varieties of oats which have the mane or side heads usually give a good appearance in the fields, but are deceiving when threshed, the yields usually dropping lower than the appearance in the field would lead one to expect.

The third column in the table gives the comparative earliness of the different varieties. In selecting oats to mix with a medium maturing barley such as the Mandscheuri or the O.A.C. No. 21 in order that they may grow and ripen together it is necessary to select an early variety of oats. For this purpose the Daubeney has been used quite extensively, and the Alaska to a more limited extent. The improved strains of the Sixty-Day and the Kherson varieties should prove serviceable for this purpose. Particular attention, however, will be given to the O.A.C. No. 3 variety as an early cropper and as a suitable variety for mixing



Field Crop Judges examining O.A.C. No. 3 variety of Oats.

with barley for grain production. Both the O.A.C. No. 3, and the O.A.C. No. 72 varieties of oats will receive particular attention and be presented in fuller detail in the following paragraphs.

TWO NEW POPULAR VARIETIES OF OATS.

In the spring of 1903 about ten thousand grains of the Siberian oats were planted separately at equal distances apart in a large nursery plot. This gave the separate plants an opportunity for development under fairly uniform conditions. When the grain was ripe the plants were all carefully examined, and those presenting the most desirable characteristics were harvested separately and carefully stored. The selected plants were afterwards given a more critical examination in the plant breeding laboratory and those possessing the largest amount of the best seed were retained for future work. In the spring of 1904 a certain number of the seeds from each of the plants were planted by hand in separate rows which furnished an opportunity for a study of the characteristics of the progeny of the individual plants. A critical study was made of these different strains, and only the best were continued in the test. From seed obtained in the rows plots were sown and the crops were compared with other selections, hybrids and varieties.

As the result of this careful investigation it was found that what is now called the O.A.C. No. 72 seemed to possess the greatest combination of the most desirable characters. This variety has now been tested in the large plots in each of the past eight years, the results of which are here presented, in comparison with those of the American Banner oats which were grown under similar conditions. The American Banner has been the variety which has been most extensively grown in Ontario during the past ten years.

The O.A.C. No. 3 variety of oats originated from a single plant selected from the regular variety plot of the Daubeney oats in 1904. The writer at that time selected a number of plants which apparently combined the most desirable characteristics. These plants were threshed separately, and the grain was carefully retained for future work. After careful tests were made with the individual strains it was found that the oat which now receives the name of O.A.C. No. 3 contained the greatest number of valuable points. The results of this particular strain are presented in comparison with those obtained from the Daubeney oats from which the plant was originally selected. These are both exceptionally early varieties and are suitable not only for growing as separate varieties, but also for combining with barley when it is desired to grow the two in combination for grain production.

The following tables give the average number of days to mature, and the average yield of straw per acre in tons, as well as the annual, and the average results in percentage of hull and in yield of grain per acre of the eight years' tests:

Varieties.	Days to Mature.	Per Ce. Hull.								
		1907	1908	1909	1910	1911	1912	1913	1914	Av.
Early Varieties:										
Daubeney	102	24.7	23.8	25.4	24.9	26.2	24.6	24.5	25.9	25.0
O. A. C. No. 3	100	24.7	23.6	24.8	24.4	25.0	23.8	23.0	24.3	24.2
Late Varieties:										
Banner	110	28.3	28.6	29.6	29.6	31.3	35.5	29.2	30.7	30.4
O. A. C. No. 72	110	27.2	25.4	28.7	28.6	27.8	28.0	25.6	28.9	27.5

Varieties.	Yield of Straw per acre. Tons.	Yield of Grain per Acre (bushels).								
		1907	1908	1909	1910	1911	1912	1913	1914	Av.
Early Varieties:										
Daubeney	1.70	80.79	88.97	98.35	87.00	42.12	76.47	60.41	63.88	74.75
O. A. C. No. 3	1.73	86.29	89.24	104.88	90.35	49.76	91.65	94.12	57.53	82.98
Late Varieties:										
Banner	1.94	65.94	83.50	70.41	73.62	30.41	73.44	74.38	88.00	69.96
O. A. C. No. 72	2.16	76.38	86.82	102.94	93.59	43.97	114.12	105.74	88.50	89.01

The results which are presented in the foregoing table are worthy of careful study as they give a comparison of two new varieties of oats with two older varieties which have been grown considerably over the Province, and which have been popular with the farmers in years past.

In time of maturity the O.A.C. No. 3 variety is two days earlier than the Daubeney, and is ten days earlier than the Banner and the O.A.C. No. 72, the last two reaching maturity at exactly the same time. In yield of straw per acre the Daubeney and the O.A.C. No. 3 are the lightest, and are about equal;

the O.A.C. No. 72 is the highest, and the Banner occupies an intermediate position.

The detailed results show that in percentage of hull the Vick's American Banner was the highest and the O.A.C. No. 3 was the lowest in each of the eight seasons, the average of the O.A.C. No. 3 being 24.2, for the Daubeney 25, for the O.A.C. No. 72, 27.5, and for the Banner 30.4. It will, therefore, be seen that each one hundred pounds of the O.A.C. No. 3 contains fully six pounds, and that each one hundred of the O.A.C. No. 72 oats contains practically three pounds of oat kern. Oatmeal more than the same weight of the Banner variety. The quality of oats is too frequently ignored in oat production. It is, however, a point of great importance.

The yields of grain per acre also show striking results. In each of the eight years the O.A.C. No. 72 surpassed the Banner variety, the average increase per acre per annum of the former as compared with the latter amounting to about nineteen bushels. The O.A.C. No. 3 surpassed the Daubeney in each of seven out of the eight years, the average for the whole period being slightly over eight bushels per acre per annum.

The two new varieties, each of which was originated twelve years ago, from a single seed, have certainly made excellent records in producing large yields of grain of superior quality. In fact, the O.A.C. No. 3 variety of oats has proven to be better in quality than any of the other three hundred named varieties of oats which have been tested in the plots at the Ontario Agricultural College.

It was in the year 1911 that the O.A.C. No. 72 variety of oats was first distributed for co-operative experiments throughout Ontario. One pound lots were sent in that year to three hundred Ontario farmers who applied for the co-operative experiment with oats through the medium of the Experimental Union. The one pound of O.A.C. No. 72 oats was compared with two or three other leading varieties on plots one rod wide by two rods long. The new variety did so well in the first year that a large number of the farmers saved their seed very carefully and sowed it on a larger plot in 1912. This seed was again carefully saved and sown on larger areas of land in the spring of 1913, and in that year thousands of bushels were grown in Ontario. At the Provincial Winter Fair held in Guelph this month there were more entries of O.A.C. No. 72 than of any other variety of oats, even of the American Banner which has been grown so extensively and has been quite popular through the Province for many years.

The O.A.C. No. 72 oats possess a long straw which is comparatively stiff, and the crop has a handsome appearance both when growing and at the time of harvest. The heads are spreading in their habit of growth, and the chaff has a pinkish cast when the crop has been ripened under favorable conditions. The grain is also of a pinkish white appearance when thoroughly ripened and harvested without being badly weathered. The grains are fairly long, the hulls are comparatively light and the kernels are generally large and plump.

The O.A.C. No. 72 variety of oats has given general satisfaction throughout Ontario. On the 11th of August last, Mr. E. P. Bradt, B.S.A., District Representative, Morrisburg, wrote as follows: "I have just completed a tour of inspection of twenty-one acre plots of the O.A.C. No. 72 oats. Without exception they are far superior to any other variety which is growing along beside them in the same field. They stand from about six to eight inches higher and are better headed and stand up better than other varieties sown under similar conditions. Nearly all the farmers who have them on their farms are very enthusiastic about them, and claim the O.A.C. No. 72 to be the best variety of oats that they

have ever had on their farms. Observing them growing under average conditions as I have this year I feel quite sure that they are a very suitable variety for this district. There is a great deal of very strong land through this County, and many of the farmers have difficulty with their grain lodging very badly, but the O.A.C. No. 72 seems to be rather good in this respect. One field I have in mind of twenty acres of oats on a new piece of land, nineteen acres was the Siberian variety, and the one acre in one corner of the field was the O.A.C. No. 72. The Siberian was down pretty badly, but the O.A.C. No. 72 stood up straight, and the straw was five feet long."

In 1913 in the co-operative experiments throughout Ontario, from which we received one hundred and eighty-seven good reports of successfully conducted experiments, on that many farms the O.A.C. No. 72 variety of oats surpassed each of the other three varieties with which it was compared by fully eight bushels per acre. The results of the co-operative experiments for 1914 will be presented at the Annual Meeting of the Experimental Union to be held on the twelfth and thirteenth of January next.

PERCENTAGE OF HULL IN OATS.

Until the last few years but little attention was given to the percentage of hull in oats either in this country or in the old land. As the result we find that in the past a number of thick hulled, and consequently, inferior varieties were grown. The percentage of hull of oats is considered of so much importance that it is thought advisable to draw particular attention to the differences in this respect as shown by varieties; also to make an examination of the percentage of hull of the different varieties over a varied number of years to see whether or not the percentage of the different kinds remain relatively the same. The chemical composition of oats varies considerably, and these variations are largely due to the percentage of hull found in the different varieties.

Varieties.	Percentage Hull.													Av. 13 Yrs.
	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	
Joanette	22.5	23.1	22.5	24.0	25.2	23.4	23.9	25.4	23.9	23.9	24.3	22.4	24.3	23.8
Daubeney	26.1	25.1	23.0	26.3	26.3	24.7	23.8	25.4	24.9	26.2	24.6	24.5	25.9	25.1
Early Dawson ..	32.6	33.7	32.4	36.0	38.1	33.7	36.6	36.8	31.4	34.1	30.8	33.1	34.4	34.5
Pioneer	48.1	36.8	36.9	36.8	42.8	38.8	37.4	36.7	33.0	36.8	37.0	35.3	36.7	38.0

It is difficult to find evidence more striking than can be secured from the tabulated results here presented in regard to the percentage of hull of different varieties of oats. With only two slight exceptions the Joanette proved to be thinner in the hull than any of the other three varieties in each of the past thirteen years. One exception occurred in 1908, when the Daubeney was one-tenth of one per cent. thinner in the hull than the Joanette, and the other instance occurred in 1909 when both the Joanette and the Daubeney had exactly the same percentage of hull. It will also be observed that with the exception of 1909 the Pioneer had a higher percentage of hull than the Early Dawson. Without a single exception the Daubeney was thinner in the hull than the Early Dawson in the thirteen year period. The average results show that the oats of the Joanette variety had only 23.8 per cent., while those of the Pioneer variety had 38 per cent. of hull annually. This makes an average annual difference of fully 14 per cent. The hull of oats is about the same in composition as straw. It will,

therefore, be seen that if the results of these two varieties were applied to the amount of oats which were grown in Ontario last year there would be a difference in the real value of the oat crop of Ontario of approximately \$5,000,000, brought about simply by the difference in the percentage of hull. It will be seen that the percentage of hull in oats has a much greater bearing on the real value of the oat crop than many people realize.

A TEST OF THE STOOING OF OATS.

It is only recently that we have given much attention to the stooing of the cereal crops, and the work which we have carried on so far has been confined largely to oats. While it is true that the stooing of the grains is influenced by the fertility of the soil, the conditions of the weather, etc., it is also true that it



A very careful test of Oats planted at seven distances apart in a study of Selection of Seed, Stooing Properties and Yield of Grain per acre.

is influenced by the variety of the grain and by the thickness of the sowing. The fertility of the soil, the thickness of the sowing, and the varieties used are largely under the control of the farmer. In the results of our own experiments in each of the past six years the varieties of oats have shown very marked differences in the stooing properties. We here present the **six years'** results of each of a number of varieties of oats which were grown under uniform conditions.

Varieties.	Number of Stools per Plant.						
	1909	1910	1911	1912	1913	1914	Av.
Joanette	21	18	15	26	16	16	19
Burt	22	13	17	19	18	17	18
Early Ripe	19	13	16	19	16	19	17
Yellow Kherson	19	13	15	18	15	13	16
Daubeney	18	11	14	14	12	9	13
Sixty-day	17	12	13	14	10	10	13
American Banner	17	10	13	14	10	11	13
Siberian	14	12	11	12	9	11	12
Abundance (Regenerated)	11	10	11	14	10	11	11
Storm King	8	6	6	9	6	5	7
Tartar King	8	5	6	8	6	5	6

Great care was exercised in the sowing of the oats in this experiment, the seed being planted in squares one foot apart. In this way the plants had an

opportunity for the development of stools and to bring out the characteristics of the individual varieties in this respect. It will be seen that there is a variation in the average number of stools, from six in the case of the Tartar King to nineteen in the case of the Joannette. It will also be seen that the three lightest stooling varieties are the Tartar King, the Storm King and the Regenerated Abundance, three varieties of oats brought out from England to Canada by the Garton Brothers, of Warrington, England. The Abundance is a fairly good yielder, but both the Storm King and the Tartar King are light yielders of grain. The American Ranner late variety, and the Daubeney and Sixty-Day early varieties occupy an intermediate position in stooling properties. The heavy stooling varieties in comparison with the light stoolers when sown broadcast under average conditions have given a somewhat higher yield of grain per acre. We are gleaning valuable information on the stooling of oats from another experiment which has been conducted in each of six years but cannot be reported at this time owing to the fact that the results for 1914 have not as yet been prepared for publication.

CLASSIFICATION OF WHEAT.

The classification of wheat assists considerably in an intelligent knowledge of the results of experiments with this important grain. Practically all are familiar with certain popular classifications of wheat but many are not so familiar with the classification from a botanical standpoint. This being true, it seems proper to enumerate the different species of wheat which are usually given. While authorities differ slightly in regard to the classification, the one which we here present is considered the simplest, and the one which has been most frequently adopted.

As we have had representatives of all the seven species of wheat under experiment for at least five years, the results in average yields of grain per acre from leading representatives of the different species should add value to the classification here presented. As all of the different species are represented by spring varieties but are not completely represented by fall varieties it was thought advisable to furnish the results entirely from the spring wheats, and in addition to give the yield per acre of one variety of winter wheat belonging to the Common type. As the standard, per measured bushel, is not the same for all the species the results are given in pounds instead of bushels of grain per acre. The following table gives the common name and the scientific name of each of the seven species of wheat, and also the name and the average yield per acre for **five years** of the variety of each species which heads the list in yield of grain:

Name of Species.	Name of Highest Yielding Varieties.	Av. Yield in pounds of Grain per Acre, 5 Yrs
Common (<i>Triticum vulgare</i>)	Grand Prize Winter Wheat	2.856
	Saxonka Spring Wheat	1.936
Turgid or toulard (<i>T. turgidum</i>)	Seven-headed	1.533
Hard or Flinty (<i>T. durum</i>)	Arnautka (1537)	1.932
Polish (<i>T. polonicum</i>)	Polish	1.132
Spelt (<i>T. spelta</i>)	Red Spelt	1.677
Emmer (<i>T. dicoccum</i>)	Common Emmer	2.298
One-grained (<i>T. monococcum</i>)	One-grained Wheat	1.535

In the case of the first four species mentioned there is a clear separation of chaff and grain, and the weights here given are for the grain which has been separated from the chaff. In the case of the last three species, however, there is

not a clear separation of the chaff and the grain, and the weights given are therefore for the grain as it is threshed, which includes the chaff and which amounts to about twenty per cent. for the Emmer and thirty per cent. for the Spelt. It is probably a little less for the One-Grained Wheat.

Of the seven different types of wheat here presented the one mentioned first in the list is the most common in this Province. To this type belongs the greater number of both the spring wheats and the winter wheats, some of which have bearded and others beardless heads. Some have red and others white chaff, and some are red wheats and others are classed as white or amber. The third species referred to in the foregoing list is represented in Ontario largely by the Wild Goose spring wheat which is grown extensively in many parts of the Province. The Wild Goose variety, however, has been surpassed in yield per acre in the average of the five years' experiments by the Arnautka, which is mentioned in the tabulated results here furnished. Emmer is grown to a limited extent in some sections in Ontario under the name of Common Emmer, but in some sections it is improperly called Spelt.

The report on wheats will be presented according to a popular classification into which the wheats readily arrange themselves. The results will, therefore, be discussed under the following headings: Varieties of Winter Wheat, Varieties of Spring Wheat for flour production, Varieties of Macaroni Spring Wheat, Emmer and Spelt for the production of grain for feeding purposes, and wheat of other species.

VARIETIES OF WINTER WHEAT.

Approximately two hundred and eighty varieties of winter wheat and a large number of selections and crosses have been grown under experiment at the Agricultural College within the past twenty-five years. Nearly all the varieties have been carefully tested in each of five years, after which the inferior kinds have been discarded and those which have given the best results have been continued in the experiments. In the last year seventy-six different lots of winter wheat were carefully tested under uniform conditions. These included thirty-nine named varieties, twenty-three hybrids, and a number of straight selections. Of the named varieties, fourteen have been grown in each of the past nineteen years and the results of these are of particular value.

RESULTS OF VARIETIES OF WINTER WHEAT.

Variety.	Color of Grain.	Pounds per Measured Bushel. 18 Years.	Yield per Acre.		
			Bushels Grain, 1914.	Average 19 Years.	
				Tons Straw.	Bushels Grain.
Dawson's Golden Chaff	White	60.0	39.9	2.9	51.1
Imperial Amber	Red	61.2	55.0	3.2	48.1
Early Genesee Giant	White	60.1	35.7	3.0	46.5
Egypt' n Amber	Red	61.8	48.0	3.2	46.4
Early Red Clawson	Red	59.0	42.9	2.8	46.1
Rudy	Red	61.6	44.4	2.7	45.0
Tasmania Red	Red	61.9	56.2	2.9	44.4
Geneva	Red	62.4	49.9	3.0	43.9
Tuscan Island	Red	61.2	50.5	2.9	43.3
Kentucky Giant	Red	61.3	39.6	2.8	43.2
Turkey Red	Red	61.4	45.0	2.7	43.0
Treadwell	White	60.1	36.1	2.8	41.7
Bulgarian	White	60.7	34.8	2.8	41.5
McPherson	Red	61.7	39.4	2.6	41.5

The average results of the fourteen varieties are as follows: yield of grain per acre 44.1 bushels for 1914 and 44.7 bushels for the nineteen year period; yield of straw per acre 2.6 tons in 1914 and 2.9 tons for the nineteen year period; and weight of grain per measured bushel, 61.3 lbs. for 1914, and 61 lbs. for the eighteen year period. It will, therefore, be seen that in the experiments at the College for 1914 the winter wheat gave an average yield of grain per acre and an average weight per measured bushel very similar to the average of the past nineteen years. The yield of straw per acre last year, however, was slightly less than the average for the whole period. In the last nineteen years the lowest average yields per acre of the fourteen varieties mentioned have been as follows: 20.2 bushels in 1912, 28.3 bushels in 1895, 32 bushels in 1908, and 34.1 bushels in 1904, and the highest yields have been as follows: 66.7 bushels in 1900, 61.6 bushels in 1902, and 60.5 bushels in 1903. In 1899 and in 1901 the results were so poor that no satisfactory tabulated returns could be made.

From enquiries made during the past year it is evident that the Dawson's Golden Chaff is still the most extensively grown variety of winter wheat in Ontario.



Convenient covers for protecting shocks of grain from rain.

This variety, in the results at Guelph for nineteen years, has given an average of three bushels per acre per annum more than any other variety. The Dawson's Golden Chaff produces a very stiff straw of medium length, beardless heads with red chaff and white grain which weighs slightly over the standard per measured bushel. There seems to be evidence that the Dawson's Golden Chaff is improving somewhat in quality for bread production. The Imperial Amber variety produces a large amount of straw which is medium in strength, a bearded head with red chaff, and red grain of very good quality. The Early Genesee Giant has a compact bearded head and a grain which is sometimes classed as white and sometimes as amber. It is interesting to note that of the four white wheats included in the nineteen year test, two are included in the three highest yielding varieties and the remaining two in the three lowest yielding varieties.

Twenty-nine varieties of winter wheat grown in 1914 have been under experiment for at least five years. In the five years' test the highest average yields in bushels of grain per acre of the named varieties have been produced by the Grand Prize, 47.6 bushels; Kharkov, 47.3 bushels; Yaroslaf, 45.9 bushels, Imperial Amber, 45.4 bushels; Tasmania Red, 44.4 bushels, and Crimean Red, 43.5 bushels. The Grand Prize possesses beardless heads, red chaff, and red grain. The Kharkov and Crimean Red have bearded heads, white chaff, and red grain, and the Yaroslaf,

The Red Fife variety which has been so well and favorably known throughout Ontario for many years occupies third place in average yield of grain per acre in the results here presented. This variety is still grown extensively in the Western Provinces. In some sections, however, it is being supplemented by the Marquis variety of spring wheat which has been grown at our College in each of the past three years, and which gave a yield per acre of 41.2 bushels in 1912, 31.8 bushels in 1913, and 27.8 bushels in 1914. This variety of wheat was originated by Dr. William Saunders, and was further selected and introduced by Dr. C. E. Saunders of the Central Experimental Farm, Ottawa. It is an early wheat, and is giving particularly good results in some sections in the West. The Prelude also originated at the Central Experimental Farm, Ottawa, has been grown at our College in each of the past two years. In 1913 it gave a yield of 23.3, and in 1914 of 21.8 bushels per acre. One of the chief values claimed for the Prelude wheat is its earliness. It reached maturity in ninety-four days in the past season, and in ninety-eight days in the year previous. In comparison with this the Marquis required one hundred and five days in 1914, and one hundred and six days in 1913 to reach maturity.

VARIETIES OF MACARONI SPRING WHEAT.

That variety of macaroni wheat which is the best known in Ontario is the Wild Goose. This wheat has been grown in Ontario quite extensively for many years past. It belongs to the third species referred to on the list, viz., the hard or flinty wheat (*triticum durum*). The wheats belonging to this type are frequently called the durum wheats and are grown quite extensively in the semi-arid regions in the central western part of the United States. The varieties belonging to this type of wheat are very hard and require much power to grind them into flour. There is not a very clear separation of the bran from the flour, which usually has a yellowish color. Especially is this true of the Wild Goose variety which, however, is being used more and more for flour production, the flour being used to mix with that of the softer varieties of winter wheat which are grown in Ontario.

Six varieties of macaroni or durum wheats were grown at the Agricultural College in 1914 for the fifth time in succession. The following table gives the average results for the five-year period of each of the six varieties:

Varieties.	Bearded or Bald.	Average Height.	Per cent. Rust.	Days to Reach Maturity.	Weight per Measured Bushel.	Yield of Straw per Acre.	Yield of Grain per Acre.
					lbs.	tons.	bush.
Arnautka (1537).....	Bearded	43	5	115	61.42	2.01	32.20
Roumania	Bearded	42	6	116	61.17	2.06	32.14
Kubanka	Bearded	44	8	115	60.91	2.07	31.10
Wild Goose.....	Bearded	44	11	117	59.05	2.12	30.92
Sorentina	Bearded	46	8	113	58.58	2.09	24.81
Medeah	Bearded	46	6	111	58.36	2.01	28.67

The Wild Goose spring wheat which is the best known durum wheat in Ontario occupies fourth place in average yield of grain per acre for five years. The Arnautka is a wheat resembling the Wild Goose quite closely in some characteristics, but in yield per acre and in weight of grain per measured bushel the Arnautka has made a very excellent record within the past few years.

As three of these varieties have been grown under experiment at the College for a period of twenty-two years, the following table is presented giving the average yield per acre for the whole period in the case of each variety:

Varieties.	Weight per Measured Bushel.	Yield per Acre.	
		Tons of Straw.	Bushels of Grain.
Wild Goose.....	lbs. 61.23	2.1	36.5
Medeah	59.97	2.1	32.9
Sorentina	59.53	2.1	31.6

It will be seen that the Wild Goose variety which surpassed the Sorentina and the Medeah wheats in the five year period has also surpassed the same varieties in the results for twenty-two years. Some of the varieties of the durum wheats which occupy the highest yield per acre are more recent introductions.

EMMER AND SPELT FOR THE PRODUCTION OF GRAIN FOR FEEDING PURPOSES.

The wheats already described representing three types or species have a distinct separation of grain and chaff at the time of threshing. Three of the other four species, however, two of which are represented by the Emmer and the Spelt, do not have a clear separation of grain and chaff on being threshed. After the crop has been threshed the grain is still surrounded by the chaff, and these two are usually ground together for the production of meal for feeding purposes. Although both Emmer and Spelt have been grown at the College more or less for over twenty years the last named grain is scarcely ever grown on the farms of Ontario. Emmer has been grown as a field crop in many sections although it is even yet in some parts of the Province improperly called Spelt. Each of these types of wheat is represented by a number of varieties. The following table gives the average of thirteen years' results of each of three varieties of Emmer and three varieties of Spelt which have been grown at the College:

Classes of Crop.	Varieties.	Average Results for 13 Years.			Weight per Measured Bushel Average of 12 Years.	Average Results for 13 Years.	
		Per cent. of Rat.	Per cent. of Crop Lodged.	Per cent. of Hull.		Straw per Acre.	Grain per Acre.
Emmer	Common	3	24	22.16	lbs. 39.7	tons. 1.9	lbs. 2,780
	Russian	2	20	24.57	39.7	1.7	2,681
	Iowa	2	20	20.36	39	1.7	2,651
Spelt	Alstrom	15	3	28.04	27.7	1.5	2,023
	Red	12	3	28.08	27.8	1.5	2,013
	White	13	2	27.35	27.6	1.5	1,888

A few years ago Emmer was introduced by some of the seedsmen under the name of Spelt, and was advertised very extensively in Canada and in the United States, and most extravagant claims were put forward for this grain. We have endeavored through our experiments to bring out the real facts in reference to these two types of wheat, and we believe that the results have had a wholesome

influence in clearing up the situation. It will be seen that the three varieties of Spelt are much more subject to the attacks of rust than are the three varieties of Emmer. It will also be observed that the varieties of Emmer are more apt to lodge than the varieties of Spelt. The percentage of hull of each of the Emmers is only about two-thirds as great as that of each of the varieties of Spelt. In the average yield of grain per acre for the thirteen years the varieties of Emmer are decidedly superior to those of Spelt, the common Emmer giving as high a yield as 2,780 pounds per annum and the highest yielding variety of Spelt giving only 2,023 pounds of grain per acre. The common Emmer forms a close rival to the best varieties of barley and the best varieties of oats for grain production in Ontario. It contains rather a larger percentage of hull than barley, but a considerably less percentage of hull than oats. Emmer is considered to be about equal to barley for feeding purposes.

WHEAT OF OTHER SPECIES.

There are two species of wheat not yet referred to, viz., the Polish (*triticum polonicum*), and the Turgid or Toulard (*triticum turgidum*). In experiments at Guelph the first named species is represented by the Polish variety, and the last named species by the Seven-Headed. As each of these varieties of wheat has been extensively advertised, and the seed has been sold at high prices, it is thought advisable to give detailed results of these two kinds in comparison with two well-known varieties of other species in order that the farmers may have clear cut evidence of the comparative value of these various varieties.

A COMPARISON OF FOUR SPECIES OF SPRING WHEAT.

Year.	Red Fife. (<i>Triticum Vulgare</i>) Bushels.	Wild Goose. (<i>Triticum durum</i>) Bushels.	Polish. (<i>Triticum polonicum</i>) Bushels.	Seven Headed. (<i>Triticum turgidum</i>) Bushels.
1897	20.7	23.1	16.3	6.5
1898	34.2	48.3	27.1	24.7
1899	39.2	44.5	24.5	26.4
1900	46.3	48.4	34.5	39.4
1901	24.1	32.1	15.6	22.2
1902	31.9	33.5	29.1	25.0
1903	43.5	47.1	32.8	34.3
1904	22.2	47.1	20.1	33.2
1905	35.9	41.5	28.7	30.8
1906	33.9	36.0	19.5	28.2
1907	28.0	53.2	18.7	19.1
1908	36.3	25.6	23.8	24.5
1909	40.1	34.8	20.4	25.7
1910	44.0	49.2	30.6	37.5
1911	10.2	14.0	1.7	5.2
1912	29.1	32.5	20.2	28.9
1913	36.7	32.8	22.7	31.4
1914	33.3	26.2	19.3	25.1

It will be seen from the tabulated results here presented that in 1904 as in practically all of the other years the Red Fife and the Wild Goose each surpassed in yield per acre the Polish and the Seven-Headed varieties. In some years the differences in the yields per acre were very marked. It will be seen that it is not always the grain which is advertised the most extensively, and which is sold at the highest prices, that will give the most satisfactory results in the Province. These, and other results as well, help to protect the farmers from unjustifiable

claims regarding certain varieties of farm crops which are occasionally advertised extensively for the sole purpose of making money through deception.

VARIETIES OF RYE.

There has been a rapid increase in rye production in Ontario in recent years. Within the last seven years the area devoted to the rye crop in Ontario has more than doubled. This being the case it is interesting to observe in detail the number of acres used for rye recently, which are as follows: 1907, 67,158; 1908, 87,908; 1909, 94,661; 1910, 95,397; 1911, 98,652; 1912, 105,949; 1913, 118,429; and 1914, 138,913. The acreage of rye in Ontario has been increasing in the last few years while that of nearly all other varieties of farm crops has been decreasing. Last year was the first time in which the acreage of rye was greater than that of spring wheat. In 1914 there were 20,311 acres more of rye than of spring wheat.

Varieties of Winter Rye.—In each of the past eleven years four varieties of winter rye have been under experiment at the College. The following average results in yield of grain per acre and in weight per measured bushel have been obtained: Mammoth White, 58.3 bushels, 57.5 lbs.; Washington, 55.2 bushels, 57.6 lbs.; Common, 53.2 bushels, 57 lbs.; and Thousand Fold, 53 bushels, and 57.4 lbs. Of the four kinds of rye here referred to the Mammoth variety gave the highest yield per acre in each of eight out of eleven years, the yield per acre in 1914 being 54.4 bushels. In strength of straw the Mammoth White and the Common proved to be the strongest and the Washington the weakest. In 1914 none of the varieties were lodged. The average height of the Mammoth White variety was about 72 inches in 1912 and 70 inches in each of the past two years. For three years in succession a German variety of winter rye known as Petkus, has been grown in competition with the four varieties here referred to, and it has produced the greatest yield of grain per acre in each of these years, the average being 60.9 bushels per acre.

Varieties of Spring Rye.—For ten years in succession three varieties of spring rye have been grown under similar conditions at the College. As a rule the Spring rye makes a shorter growth and gives a lighter yield of grain per acre than the winter varieties. It grows very rapidly, however, and is usually free from smut and from rust. The following table gives the average results for ten years of each of three varieties of spring rye:

RESULTS OF VARIETIES OF SPRING RYE.

Varieties.	Weight per Measured Bushel.	Straw Per Acre.	Grain Per Acre.
	lbs.	tons.	bushels.
Petkus	55.05	2.04	29.01
Common	54.73	1.93	25.66
Prolific Spring.....	54.83	1.87	25.60

The Petkus variety of spring rye has surpassed the Common variety by nearly three bushels per acre per annum for the ten year period. This variety was secured from the greatest rye breeder in Germany in 1901. It did poorly at first when grown in Ontario, but after the first three years it surpassed other varieties in each season with but one slight exception. One of our own selections, however, has surpassed the Petkus rye, and is described under the following separate heading:

O.A.C. No. 61 Rye.

From the Petkus variety of rye obtained in Germany a number of the most promising plants were selected, and these were tested out separately. Amongst these different strains one has proven of superior merit and has now been under cultivation in the experimental grounds in competition with the other varieties in each of seven years under the name of O.A.C. No. 61. In the average of the seven years' experiments, under uniform conditions, the following average annual yields per acre have been obtained from each of the four varieties: O.A.C. No. 61, 28 bushels; Petkus, 26.8 bushels; Common, 23.5 bushels; and Prolific Spring, 23.4 bushels. It will, therefore, be seen that the O.A.C. No. 61 has surpassed the Petkus, from which it was selected, by an annual average of one and four-fifths bushels per acre, and also that it has surpassed the Common spring rye by an average of four and one-half bushels per acre per annum. The O.A.C. No. 61 surpassed the Common variety in the co-operative experiments over Ontario by an average of four bushels per acre in 1913.

VARIETIES OF BUCKWHEAT.

From 1901 there has been an increase in the acreage of buckwheat in Ontario until 1913, in which year there was decidedly more buckwheat grown than in any season for at least thirty years. In 1901 the acreage was 88,266, and in 1913, it was 228,279. In 1914, however, the number of acres dropped to 177,227. In one year the decrease was practically as great as the increase for the five years previous. With the exception of the five years, however, from 1909 to 1913, inclusive, there was a greater acreage in buckwheat in Ontario this year than in any other year in which Ontario's statistics have been collected through the Bureau of Industries. The following table gives the average results of ten years' experiments with each of five varieties of buckwheat:

RESULTS OF VARIETIES OF BUCKWHEAT.

Varieties.	Weight per Measured Bushel.	Yield of Straw per Acre.	Yield of Grain per Acre.
	lbs.	tons	bushels.
Rye Buckwheat.....	51.37	2.5	32.88
Common Grey.....	46.05	3.17	22.63
Japanese	44.61	3.24	22.36
Silver Hull.....	50.37	3.12	21.71
New Calcutta.....	48.40	3.31	20.31

The Rye Buckwheat which occupies highest place in yield of grain per acre in the average results for ten years has not been grown in Ontario extensively, but has been produced to a considerable extent in the Maritime Provinces, and especially in Nova Scotia. It is interesting to note that there is a difference in yield of over ten bushels per acre per annum between the two highest varieties, and an average difference of slightly over two bushels per acre in the four other varieties. The Rye Buckwheat also weighed more per measured bushel than any of the other kinds, but was considerably lighter in average yield of straw per acre. The flour of the Rye Buckwheat as compared with that of the other varieties has a yellowish color. The grain itself is not as attractive as that of the Silver Hull variety, and it is possible that the hull may be a little thicker than that of the last named variety.

VARIETIES OF FIELD PEAS.

It is to be regretted that there has been such a great falling off in the growing of peas in Ontario during the past eighteen years. In 1807 no less than 896,735 acres were used for the pea crop. In the following year there were 865,951 acres of peas. With three or four slight exceptions the acreage from that time to the present has been gradually decreasing until the last two years, in each of which there has been less than 200,000 acres of peas grown in Ontario. There is a good strong demand for peas of good quality. The writer frequently receives enquiries from buyers regretting the rapid decline of this crop for the last four or five years, and it is to be hoped that with more favorable seasons Ontario will again increase the acreage of the pea crop. When good yields of field peas can be obtained in Ontario they form an excellent crop for the land, and produce feed of superior quality, being exceedingly rich in digestible nutrients.

In order to give as much assistance as possible the Ontario Agricultural College has tested a large number of varieties of peas obtained from different parts of the world, in order to ascertain the most suitable kinds for grain production in Ontario. Many of the lower yielding varieties have been dropped, after being carefully tested, and only the most productive kinds have been retained. The following table gives the average results of **fifteen years'** experiments with each of eight varieties of peas which have been tested under uniform conditions:

RESULTS OF VARIETIES OF FIELD PEAS FOR FIFTEEN YEARS.

Varieties.	Color of Grain.	Days to Ma- ture, Average 15 Years.	Length of Vine, Average 13 Years.	Average Results for 5 Years.			
				Weight per Mea- sured Bushel.	Straw per Acre.	Grain per Acre.	
Early Britain.....	Light Brown..	104	ins.	57.47	1.38	35.78	bus.
Potter	White	105	43	59.64	1.41	34.48	
Black Eyed Marrowfat.....	Smoky White.	107	41	59.97	1.39	30.43	
New Canadian Beauty.....	White	106	44	60.73	1.38	30.10	
White Eyed Marrowfat.....	White	107	41	61.15	1.42	28.47	
Prussian Blue.....	Bluish Green.	109	43	60.46	1.56	27.09	
Golden Vine.....	White	107	42	60.39	1.48	28.85	
Multipliers	White	111	47	60.70	1.72	25.25	

The Early Britain occupies the highest place in yield of grain per acre, producing an average annual yield of fully ten bushels per acre per annum more than the Multipliers, and about nine bushels per acre more than the Golden Vine, the last named variety being the common white field pea of Ontario. The Early Britain peas are of a brown color and it was thought at one time that they would not be as saleable a pea as the white varieties, but Mr. Murton, a split pea manufacturer in Guelph, is responsible for the statement that the Early Britain variety is particularly suitable for the manufacture of split peas, and he would like to see the cultivation of this variety greatly extended in the Province. He states that the manufactured product is of a rich golden color.

The following table gives the average results of each of eighteen varieties of peas grown at the College for four years in succession:

Varieties.	Color of Grain.	Days to Mature, Average 4 Yrs.	Length of Vines, Average 4 Yrs.	Average Results for 4 Years.		
				Weight per Measured Bushel.	Yield of Straw per Acre.	Yield of Grain per Acre.
No. 12887 (Wash.)	Brown	110	ins.	lbs.	tons.	bus.
No. 20467 (Wash.)	Brown and Green.	105	38	60.88	1.65	33.65
Blue Maple	Brown	110	37	59.24	1.50	33.39
Spanish No. 22077 (Wash.)	Brown	110	38	61.31	1.65	33.12
Potter	Brown	101	30	55.48	1.19	32.13
Solo Peas (L. H. Newman)	White	109	40	59.60	1.31	30.88
Early Britain	Greenish Brown.	106	33	60.06	1.42	30.61
Clamart	Light Brown	108	38	57.95	1.42	30.59
Shannon Peas	White	102	37	58.89	1.09	28.11
Abyssinia 22078 (Wash.)	Light Brown	103	38	55.31	1.11	27.89
No. 18806 Green (Wash.)	Brown	113	41	57.03	1.70	27.27
Black Eyed	Green	94	27	57.84	.96	27.12
Golden Vine	Smoky White	111	37	60.61	1.29	26.98
Prussian Blue	White	112	42	61.56	1.64	24.06
New Canadian Beauty	Bluish Green	112	37	62.26	1.58	23.99
White Wonder	White	111	38	61.34	1.23	23.36
White Marrowfat	White	100	17	60.78	.83	22.42
Multipliers	White	111	39	62.11	1.11	20.33
		113	44	61.78	1.72	19.90

In the larger number of varieties grown for a shorter length of time it will be seen that several of the new varieties appear near the top of the list in average production. Of the four highest yielding varieties three were obtained through the Department of Agriculture at Washington, and each of these have produced an average of over 32 bushels of grain per acre per annum for the four year period. The Early Britain, although producing over thirty bushels per acre on the average, is surpassed by six other varieties in the four years' experiment. It will be seen that the Multipliers also occupies lowest place in yield per acre in the experiments for four years as well as in that for fifteen years.

VARIETIES OF FIELD BEANS.

Field beans are grown in all the counties of Ontario, but those counties which produce the greatest acreages are Kent, Huron, Elgin, Welland, Middlesex, Norfolk, Lanark and Brant. We are pleased to note that there has been a gradual increase in bean production in Ontario from 1909 to 1912, although there is a decrease in the acreage of the last two years. In 1914, however, there were upwards of 50,000 acres of beans grown in Ontario. Seven varieties of beans have been grown in the Experimental Department at Guelph in each of fifteen years, and the following gives the average results for the whole period for each of the seven varieties in weight of grain per measured bushel, and in yield of grain per acre:

VARIETIES OF FIELD BEANS.

Varieties.	Weight per Measured Bushel.	Yield of Grain per Acre.
	lbs.	bus.
Pearce's Improved Tree	64.61	23.32
Schofield Pea	65.13	21.52
White Wonder	64.84	20.67
Medium or Navy	64.95	20.80
Marrowfat	64.56	19.43
Small White Field	64.54	18.13
Large White Haricots	59.65	17.36

All varieties here reported are white skinned shelled beans. It will be seen that there is a difference in yield of grain per acre per annum of about six bushels between the highest and the lowest varieties. The Pearce's Improved Tree bean has taken a decided lead over all other varieties. This variety has given an average of 1.8 bushels per acre per annum more than the variety coming next in yield of grain per acre. The Small White Field bean occupies second to the bottom of the list with fully five bushels per acre less than the Pearce's Improved Tree variety.

In the average results of seventeen varieties and selections grown in each of the past five years the Pearce's Improved Tree bean heads the list in 22 bushels per acre, followed by the Scholfield field bean, 21.7 bushels, and the Large White Haricots, 20.3 bushels. All other varieties have given an average of less than 20 bushels per acre per annum. In cooking tests which have been made with different varieties of beans at the Macdonald Institute, Guelph, the Pearce's Improved Tree bean proved very satisfactory in cooking qualities.

VARIETIES OF SOYA OR SOJA BEANS.

Japanese beans are known under the name Soya or Soja, and are grown in a commercial way in a few of the States of the American Union, but as yet have not been introduced extensively in cultivation in Ontario. They have, however, been grown in an experimental way for some years past. Seed of one or two of the best varieties has been distributed for co-operative experiments in the spring of the year for a number of seasons. Many of the varieties which are grown in the United States are entirely too late to mature in this Province. We have been testing some of the most promising varieties obtained from Japan, Russia, and the United States with the idea of ascertaining whether or not any of these sorts would give satisfactory results in the Province. Soy beans furnish exceedingly rich feed for farm stock, and the plants may be cut and converted into silage, or they may be allowed to ripen for the production of grain. Upwards of thirty varieties have been under experiment at the College, but the most of these have proven to be unsuitable for cultivation in this climate. In 1914 twenty-one varieties and selections of Soy beans were grown under similar conditions at the experimental grounds, Guelph. Of this number eight have been grown for **six years** in succession, and the following table gives the average number of pounds per measured bushel, and the average number of pounds of grain per acre of each of the varieties:

RESULTS OF VARIETIES OF SOY BEANS.

Varieties.	Average number of pounds per measured bushel.	Average number of pounds of grain per acre.
O. A. C., No. 81.....	58.0	850
Buckshot, No. 17251.....	54.9	808
Habara, No. 20405.....	53.6	798
Chernie, No. 18227.....	57.9	797
Early Yellow.....	57.1	729
Ito San.....	57.4	702
Brown.....	57.8	701
Tsurunoko.....	55.2	677

Three of the varieties under experiment were obtained through the Department of Agriculture at Washington. These occupy second, third and fourth places in the list in average yield per acre. All varieties, however, were surpassed

by a selection made at the College which was started from an individual plant selected from the Early Yellow variety. The O.A.C. No. 81 has given about 40 pounds of grain per acre more than the next highest yielding variety, and about 180 pounds per acre more than the variety occupying lowest place on the list. The O.A.C. No. 81 variety has surpassed the Early Yellow Soy bean in each of five out of the last six years. In each of the past two years we have had two selections of the Soy beans obtained from the Macdonald College, Quebec, through the kindness of Professor Klinck, under the names of Quebec No. 92 and Quebec No. 537. In yield of seed per acre the Quebec No. 92 surpassed the Quebec No. 537 considerably. In 1913 the O.A.C. No. 81 surpassed the Quebec No. 92, and in 1914 the Quebec No. 92 gave a little higher yield than the O.A.C. No. 81 variety. The experiment with these varieties will be continued for some time. In 1914 a variety was obtained from the Board of Trade, Saskatoon, Sask. This was from a direct importation from Manchuria, and it is considered to be one of the very best varieties. This variety surpassed slightly either the Ontario or the Quebec selections, and was only surpassed by the Habara in the present year.

VETCHES FOR SEED PRODUCTION.

It is only to a limited extent that the Vetches have been grown in Ontario, although the Common Spring variety has been used to a small extent by the mixing of oats for the production of green fodder and of hay, and the Hairy Vetches as a cover crop in some of the orchards in the southern part of the Province. The Vetches are leguminous crops and furnish feed which is rich in nutritive constituents. The Common Vetches have been tested at the College, and when grown separately have usually proven a failure from the standpoint of seed production.

The Hairy Vetches may be sown either in the spring or in the autumn. Much has been written regarding their value as a crop for Ontario. The seed is nearly all imported and is quite expensive, frequently costing from five to six dollars per bushel. It has been found through experiments that the seed can be grown in Ontario with a fair amount of satisfaction. In experiments covering a period of thirteen years, in which Hairy Vetches were grown in the autumn for the production of seed in the following year, an average of 7.74 bushels of seed per acre has been obtained. In three of these years the yield was upwards of 18 bushels per acre per annum, and in four other years less than 2 bushels per acre. In 1913 the crop was a failure, owing to the fact that it was killed out in the winter and the early spring more than in any year during the entire experiment. In 1914 the yield of seed was 8.6 bushels per acre. The Hairy Vetches which have been grown at the College for several years have produced about 50 per cent. greater yields of seed per acre than the Hairy Vetches which have been imported more recently.

In the southern part of Ontario some farmers are sowing rye and vetches together. The rye tends to keep the vetches from the ground and to increase the production of a good quality of seed. This seems to give rather better satisfaction than when the Hairy Vetches are grown by themselves. Occasionally Hairy Vetches are sown in the spring of the year for seed production, but the results are not nearly as satisfactory as those obtained from the autumn sowing. The autumn sowing usually produces about double the amount of seed as that obtained from sowing in the spring.

GRASS PEAS.

Grass Peas have been grown in Ontario for many years. They are used both for the production of fodder and of grain. Some years ago Grass Peas were grown as a regular grain crop. The grain was ground into meal, and the

meal which was rich in valuable food constituents was used in small quantities to increase the value of the meal ration of other grains. The Grass Pea is an annual legume. The stems of the plants are flat and the whole crop is greatly relished by animals when used as a green fodder. The flowers are white in color. The grain is angular in form, very hard, and is immune to the attacks of the pea weevil (*Bruchus pisi*).

In 1914, the Grass Pea, as a grain producer, was a failure. In the average of the past ten years, however, the yield has been 678 pounds of grain per acre. Under similar experiments the Early Yellow Soy Bean has given 803 pounds and the Ito Soy Bean 794 pounds per acre. The Grass Peas have not done as well at the College in recent years as they did formerly, and the crop has decreased considerably in Ontario, and it is now but little grown.

COW PEAS.

The Cow Peas occupy a somewhat similar position in the Southern States to that occupied by Common Red Clover in Ontario. Nearly all the varieties of Cow Peas, however, are quite unsuitable for this Province. Only two varieties of Cow Peas were grown in the experimental grounds during the past season. In former years, however, we have grown many varieties, but practically all have required too long a season for development and the crop is usually a failure. The two varieties grown in 1914 were the Whip-poor-will and the Wonderful. Neither of these varieties produced seed. Although much is said and written in regard to the value of the Cow Peas in the Southern States, we must remember that the conditions in Ontario are quite different. The farmers of Ontario should give their attention to those classes of farm crops which will prove the most suitable for their particular conditions.

VARIETIES OF FLAX FOR SEED PRODUCTION.

There were 6,025 acres of flax grown in Ontario in 1914. This acreage is only about one-half of that of 1913. We had under experiment at the College in the present year ten different varieties or selections or strains of flax. These varied in seed per acre from 3 bushels given by the Golden to 25.6 bushels obtained from the Common Ontario variety. In the average results of six varieties grown in each of the past four years the Common variety has given the highest yield, viz., 22.4 bushels, and the Canadian Flax obtained from Manitoba some years ago, second highest with 22.2 bushels per acre. The next highest yield was produced by the Minnesota No. 25, a specially selected strain, which has given an average of 22 bushels per acre per annum. Seed obtained from the Argentine Republic under similar conditions has produced only an average of 16.2 bushels per acre. It will, therefore, be seen that there is a very marked difference in the yield per acre of some of the different lots of flax.

VARIETIES OF MILLET FOR SEED PRODUCTION.

We have no statistical report through the Ontario Bureau of Industries of the amount of millet grown in Ontario annually. Millet sometimes forms an important crop in Ontario more particularly to supplement the hay crop when it is found that there are poor prospects for a good crop of hay. Therefore, it is quite natural that in some years the crop is grown more extensively than in others. This will also explain how it is that the price of seed varies so much in the different years, as in some seasons there is almost no demand for the seed, while in other years the demand is heavy. The crop is, of course, grown for green fodder and for hay as well as for seed, but in this section of the bulletin only the results of the experiments in seed production find a place.

Twenty-one varieties and selections of millet were under test in the experimental grounds in 1914. Of this number, ten varieties have been under test in each of five years and seven varieties in each of eleven years. The following table gives the average yields per acre of each of ten varieties for the five year period:

RESULTS OF VARIETIES OF MILLET FOR FIVE YEARS.

Varieties.	Type of Head.	Number of days in reaching maturity.	Average Height.	Weight per Measured Bushel.	Yield per Acre.	
					Straw.	Grain.
			ins.	lbs.	tons.	bus.
Kursk	Foxtail	95	28	54.6	2.63	45.9
Canary Bird	Foxtail	95	28	54.7	2.64	45.0
Steele Trust	Foxtail	91	33	54.3	2.78	41.2
Golden Wonder	Foxtail	90	32	52.8	3.32	40.0
Siberian	Foxtail	90	31	53.4	2.73	40.0
Hungarian	Foxtail	91	32	53.5	2.83	37.0
German or Golden	Foxtail	90	33	53.9	2.13	33.3
Holy Terror Gold Mine	Foxtail	94	34	50.6	3.36	33.3
Common	Foxtail	91	34	54.0	2.12	31.9
Early Foxtail (75 Nichi)	Foxtail	96	36	52.1	2.81	27.5

The Kursk and the Canary Bird varieties are reported in tabulated form in 1914 for the first time. These two varieties are very similar in all characteristics. The seed of the first named variety was obtained under the name of Kursk from Northrop, King & Co., Minneapolis, Minnesota, and that of the second named millet under the name of Canary Bird from John Lewis Childs, Floral Park, New York. Both these varieties were obtained in the spring of 1910. Each of these varieties have given an average of fully eight bushels per acre per annum more than the Hungarian Grass, and about thirteen bushels per acre per annum more than the Common millet.

RESULTS OF VARIETIES OF MILLET FOR ELEVEN YEARS.

Varieties.	Average results for 11 years.	
	Weight per measured bushel.	Grain per acre.
	lbs.	bus.
Siberian	53.6	46.7
Steele Trust	54.6	44.9
Hungarian	53.7	42.2
Holy Terror Gold Mine	50.9	37.9
Golden Wonder	52.2	36.0
German or Golden	53.5	34.2
Common	54.1	34.0

In this experiment covering a long period of time it will be seen that the Siberian variety comes at the head of the list and that the Common variety occupies lowest place, the difference between the two being 12.7 bushels of seed per acre per annum. The Hungarian Grass has given an average of four and one-half bushels per acre per annum less than the Siberian, and fully eight bushels per acre more than either the Common or the Golden millet.

A selection of the Siberian millet made at the College from a single plant stands higher in yield of seed per acre than the Siberian variety in the average of five years' experiments by two bushels of seed per acre per annum. Even this

selected strain, however, has not produced as much seed per acre as either the Canary Bird or the Kursk varieties.

SUNFLOWERS FOR SEED PRODUCTION.

Sunflowers have been grown to a limited extent for the production of seed. The seed of the sunflowers has been quite highly recommended as a poultry feed. Evidently but little work has been done, however, in the testing of the different varieties of sunflowers as crop producers at experiment stations in the United States or in Canada other than at Guelph. A number of years ago seven varieties of sunflowers were obtained and grown under uniform conditions on our experimental grounds. In a short time some of these varieties were dropped, but those which have made the highest records have been continued in the experiment. In the average of sixteen years' experiments we obtained the following yields: pounds of seed per acre per annum: Mammoth Russian, 1,178.2 lbs.; Black Giant, 1,151.6 lbs.; and White Beauty, 1,134.7 lbs. Reckoning the standard weight per measured bushel of the sunflower seed to be twenty pounds we would have an average of 73.64 bushels per acre of the Mammoth Russian variety. This variety has given an average of about eighteen tons of total crop per acre per annum. The White Beauty variety, which grows the shortest stalks, produces heads of the greatest size, but has given the lowest yield of seed per acre. The sunflowers are very hardy and usually produce good returns when many of the other crops are almost failures.

VARIETIES OF CORN FOR GRAIN PRODUCTION.

In 1914 there were 290,817 acres of husking corn in Ontario. This was 9,000 acres less than in 1913 and an average of 18,000 acres less per annum than that for the past twenty-three years. It should be understood that, while there was a decrease in husking corn, there has been a decided increase in the acreage used for corn for fodder and for the silo.

Experiments have been conducted at the College with a large number of varieties of corn, some of which do not ripen sufficiently to obtain satisfactory yields of grain crops for a series of years. Some of the earlier varieties, however, practically always furnish grain which has been sufficiently matured to give satisfactory yields. It should be remembered that Guelph is located about thirty-five miles from any of the large lakes and at an elevation of 1,100 feet above the sea level. The climate, however, is fairly representative of the Province, being colder than some sections and much warmer than others.

Varieties.	Color of Grain.	Average Number of Rows per Ear.	No. of Days Until in Full Tassel.	Average Re- sults for 5 Yrs.	Average Results for 7 Years.	
			Height of Plants.	Weight of Freshly Cut Stalks and Leaves.	Shelled Grain per Acre.	
			ins.	tons.	bus.	
Early California Flint.....	Yellow	12	81	85	9.38	58.84
University, No. 13.....	Yellow	16	81	90	9.01	55.00
Early White Cap Yellow Dent....	Yellow	14	81	90	8.99	54.17
Genesee Valley	Yellow	8	82	86	11.27	51.22
Longfellow	Red & Yellow.	8	81	87	11.20	50.42
Red Blazed.....	Yellow	8	81	89	9.95	49.65
Compton's Early	Yellow	12	85	88	11.16	47.58
Sterling White Dent.....	White	14	85	89	9.69	44.54
Canada Yellow.....	Yellow	8-12	84	86	11.67	43.81
Salzer's North Dakota.....	White	8	89	93	14.56	40.29

In the tabulated results here presented all are flint varieties except the University No. 13, the Early White Cap Yellow Dent and the Sterling White Dent. One of these three dents occupies second place from the top and the other third place from the bottom of the list in yield of grain per acre. The Salzer's North Dakota came at the bottom of the list in yield of grain per acre. This is probably accounted for by the fact that it is a later maturing variety and produces a larger total crop than any of the other varieties here reported. In the tabulated results which will be reported on fodder corn it will be found that the Salzer's North Dakota stands second in yield of total crop per acre in the long list of forty-three varieties under test. It is a corn rather more suitable for silage in the vicinity of Guelph and for grain production in sections which are a little more favorable for corn production.

VARIETIES OF SORGHUM FOR SEED.

Upwards of thirty varieties of sorghum have been tested for seed production at the College within the past few years. These include different varieties of broom corn, non-saccharine sorghum (also called sugar cane), Kaffir corn, Jerusalem corn, milo maize, etc. There are marked differences between the classes of sorghum and also between the varieties of the different classes. The sugar canes, or more properly sugar sorghums, contain a high percentage of sugar, while all of the other types of sorghum are non-saccharine. In 1914, there were ten varieties of sorghum under test for seed production. The greatest yields were produced by the Improved Evergreen Broom Corn, the California Golden Broom Corn, and the Early Minnesota Sugar Sorghum. The broom corns are rather earlier than the sugar sorghums and are, as a rule, higher producers of seed. The broom corns are grown more particularly for the production of the heads for the manufacture of brooms and whisks than for the production of fodder or seed. Of the sugar sorghums the Early Minnesota and the Early Amber have proven to be two of the very best. The Early Amber variety, which has been grown successfully in Ontario for a number of years, is a most prominent variety for cultivation in this Province. It is used for pasture, for grain production, for dry fodder, and for seed. The three varieties of sugar cane which have been grown for seed production in each of ten years, have given an average yield of seed per acre as follows: Improved Evergreen Broom Corn, 21.4 bushels; California Broom Corn, 21.2 bushels, and Early Japanese Broom Corn, 21.0 bushels.

The sorghums appear to do particularly well on warm, rich, sandy loam. The sorghums are sown and cultivated in a somewhat similar manner to that of corn, but the rows are usually placed a little closer together.

EXPERIMENTS IN POTATO GROWING.

The potato crop in Ontario in 1914 was an exceptionally good one. There were 167,592 acres of potatoes in the Province. This area has been surpassed only nine times in the last thirty-three years. The highest acreage in that length of time was in 1895, when there were 184,647 acres of potatoes in Ontario. Not only was the acreage large in the past season, but the average yield per acre for the Province was 159 bushels, in comparison with 119 bushels in 1913 and 117 bushels in the average of the past thirty-three years. The only season in the last thirty-three years in which the yield per acre of 1914 was surpassed was in 1884, when the average reached 163.2 bushels per acre. In 1895 the yield per acre was the same as that of the present season. There were produced in Ontario in 1914 26,717,587 bushels of potatoes. With such a large crop it is but little wonder that the prices of potatoes are comparatively low at the present time. Owing to

the bulky condition of the potatoes they are less suitable for transportation over long distances than some of the more concentrated food products which contain a decidedly smaller amount of water, such as seeds of various kinds and animal products. At a time when a crop is plentiful and cheap, however, many people turn to something else and frequently the price increases rapidly in a comparatively short time. It would, therefore, be wise for the farmers of Ontario to be watchful so as not to compel the Province to import a large quantity of potatoes in 1915.

Many experiments have been conducted at the College in potato growing in the past few years and the results have been presented from year to year in the annual reports. The crop in 1914, as well as that of 1913, was comparatively free from rot. In 1912, however, the rot was very plentiful at Guelph and in many parts of Ontario. It might be well to name a few varieties which were the freest of rot in 1912, as there was a marked difference in some of the kinds in this respect. Those varieties of potatoes which showed the smallest percentage of



Planting Experimental Potatoes under uniform conditions.

rotten tubers at the time of harvest were as follows: Extra Early Eureka, 3 per cent.; Stray Beauty and Irish Cobbler, each 5 per cent.; Early Ohio, 6 per cent.; Pan American, 7 per cent.; and Early Fortune and Irish Cups, each 9 per cent. Those varieties which showed the highest percentage of rotten tubers were as follows: Carman No. 1, 84 per cent.; Canadian Standard, 62 per cent.; Norcross, 61 per cent.; Uncle Sam, 58 per cent.; Eldorado, 54 per cent.; Crown Jewel, Vermont Gold Coin and Rural New Yorker No. 2, each 42 per cent. Of the late potatoes which were freest from rot the Davies' Warrior, the American Wonder and the Delaware were amongst the best.

In 1914 the highest yields of potatoes per acre were obtained by the Pan American, 307.5 bushels; Isle of Jersey, 292.1 bushels; Noxall, 278.3 bushels; Sir Walter Raleigh, 276.7 bushels; Krouse's First Choice, 248.3 bushels; Delaware, 245.8 bushels; and American Wonder, 243.8 bushels. The early potatoes did not do as well in 1914 as they did in the year previous, as in that season they produced some of the largest yields per acre. The Davies' Warrior, which has given high yields per acre in the last few years and which is a late potato, did

not yield as heavily in 1913 and in 1914 as previously, the yield in 1914 being 218.3 bushels per acre. The Empire State, which is also a late potato, gave a yield in 1914 of only 166.3 bushels per acre, which was exceptionally low for this variety which has been such a valuable potato in Ontario. Taking the average results for the last few years we find that the Extra Early Eureka has made the highest record of the early potatoes. The Burpee's Extra Early and the Rose of the North are two of the medium ripening varieties, and the Davies' Warrior, the Empire State and the Rural New Yorker No. 2 are among the best of the late or general crop varieties.

As the result of an experiment which has been conducted at the College in the last few years the treatment which has given the best satisfaction for checking the scab on potatoes has been to soak the potatoes for two hours in a solution made by mixing one pint of forty per cent. formaldehyde with thirty gallons of water. This quantity of solution is sufficient for treating from fifteen to twenty bushels of potatoes. If only a few bushels of potatoes are to be treated, a smaller amount of solution can be made by using lesser amounts of formaldehyde and water and retaining the same proportion.

The results of many of the other experiments with potatoes have either been presented in former reports or the experiments are still under way. Much has been done in spraying in different ways for the prevention of the blight, in planting at different dates, in using seed of different stages of maturity, and in recent years considerable work has been done in the improvement of varieties by selection, etc.

THE PRODUCTION OF ROOT CROPS IN ONTARIO.

There has been a decrease in the acreage in the past four years of mangels, sugar beets, turnips and carrots. From a study of the statistical reports of the Bureau of Industries for Ontario we find that there has been a gradual decrease in the acreage of turnips in Ontario since 1900, in which year there were 156,583 acres. In 1913 there were 97,572 acres and in 1914, 95,371 acres devoted to the turnip crop in this Province. The acreage used for the mangel crop reached its maximum in 1903, when there were 80,918 acres used for mangel growing in Ontario. The number of acres dropped to 69,035 two years later, and has practically held its own since that date, although in 1913 there were only 54,568 acres and, in 1914, 50,663 acres. Within the past few years the area devoted to fodder corn has increased and that devoted to the root crops has decreased. This may be accounted for principally from the fact that the spring work has been somewhat backward, owing to the unfavorable weather conditions in some seasons, to the scarcity of skilled labor, and to the fact that some of the root seed, especially the mangel seed, has been only fair in germination. In making a survey over the past thirty years it was found that the average number of acres per annum of mangels and sugar beets grown in Ontario in each of three ten-year periods has been as follows:

1883-1892	20,172 acres.
1893-1902	45,426 acres.
1903-1912	81,836 acres.

The average number of acres per annum of mangels and sugar beets for the past two years has been 71,425 acres. The tendency appears to be a decrease in the acreage used for the production of turnips and carrots and an increase in that used for the growing of mangels and sugar beets in Ontario, although there has been an apparent decrease in the last two crops during the past couple of years.

VARIETIES OF MANGELS.

Of all the root crops grown in Ontario, mangels have been increased the most substantially within the past twenty-five or thirty years. The market value of this crop in Ontario now amounts to about two and one-quarter million dollars annually. Mangels are classified into long, intermediate, tankard and globe, according to their shape, and each class is represented by a number of varieties. Some of these varieties vary greatly, not only in shape, but also in size and color. In our experimental grounds we have tested mangels under about one hundred and twenty-five names. In a few cases, however, the mangels under different names resemble one another so closely that they may be considered as the same variety, and yet we frequently find differences in purity of seed, in germination, and in productiveness even of these mangels, owing no doubt to the varying conditions under which the seed has been grown, harvested, stored, etc. It is very difficult, indeed, to get a definite knowledge of the different varieties of mangels



An experiment in Germination of Mangels, the plants to be counted, thinned and allowed to produce roots in a comparative test of yield.

from seedsmen's catalogues. The importance of carefully conducted experimental work is evident in order that the different varieties may be grown and studied under uniform conditions.

Mangel seeds are about the size of the seeds of common red clover. The seed, however, is produced in a form of clusters. These clusters, as bought at a store, may contain one seed each, or may contain even as high as seven seeds per cluster. There has not, as yet, been any satisfactory way of breaking the clusters so as to get a suitable separation of the individual seeds. In practically all cases, therefore, it is the clusters which are sown in the case of mangels and also in the case of sugar beets.

In the experimental work with different varieties of mangels, which has been conducted at the College, great emphasis has been placed on the germination of the seed. The varieties have all been planted from two to three times each season. In every instance the land has been marked in both ways and exactly the same

number of clusters have been planted. After germination takes place and young plants have reached a height of about two inches the number of plants has been carefully counted and records made. The plants have then been thinned so as to leave one plant in each place. In a few instances, however, the germination has been so poor that even with all the great care taken and the large amount of seed used, it has been exceedingly difficult to secure a perfect stand. As the work has been repeated each year, however, and has been conducted from season to season we present the average results in yield per acre as shown by the different varieties and the different strains of the same variety for a five year period.

RESULTS OF VARIETIES OF MANGELS.

Varieties.	Weight per Root.		Yield of Tops per Acre.		Yield of Roots per Acre.	
	lbs.	tons.	tons.	bus.	tons.	bus.
1 Sutton's Mammoth Long Red.....	2.78	4.77	24.07	802		
2 Ideal (Ontario Seed Co.).....	3.05	2.90	23.96	799		
3 Hartmann's Sludstrup-Barres.....	3.28	3.52	23.21	774		
4 Yellow Leviathan (Steele, Briggs).....	2.74	3.82	23.20	773		
5 Steele, Briggs Giant Yellow Intermediate.....	2.61	3.92	23.13	771		
6 Yellow Leviathan (Rennie).....	2.75	3.83	23.02	767		
7 Yellow Leviathan (Keith).....	2.64	3.02	22.61	754		
8 Hartmann's Taaroje-Barres.....	3.04	2.72	22.41	747		
9 Von Arnim's Clewener.....	3.29	2.13	21.92	731		
10 Yellow Leviathan (O.A.C.).....	2.80	5.03	21.86	729		
11 Yellow Leviathan (Ferry).....	2.61	3.78	21.81	727		
12 Sutton's Prize Winner Yellow Globe.....	2.56	2.13	21.80	727		
13 Garton's Improved Yellow Globe.....	2.38	2.09	21.71	724		
14 Yellow Leviathan (Simmers).....	2.50	2.78	21.53	718		
15 Carter's Windsor Prize Taker Yellow Globe.....	2.34	2.06	21.34	711		
16 Garton's Large Yellow Intermediate.....	2.43	2.34	21.25	708		
17 Rennie's Selected Mammoth Long Red.....	2.47	4.29	21.18	706		
18 Yellow Leviathan (Hewer).....	2.53	3.31	21.09	703		
19 Svalof's Barres Half Long.....	2.94	3.59	21.08	703		
20 Rennie's Perfection Mammoth Long Red.....	3.01	4.55	21.05	702		
21 Mette's Mammoth Long Red.....	2.44	4.91	21.03	701		
22 Steiger's Yellow Leutewitzer.....	2.42	4.92	21.00	700		
23 Steele, Briggs Prize Mammoth Long Red.....	2.73	4.64	20.84	695		
24 Bruce's Mammoth Red Intermediate.....	2.64	2.84	20.76	692		
25 Dippe's Red Mammoth.....	2.47	4.84	20.42	681		
26 Hartmann's Danish Eckendorfer Red.....	2.82	2.22	20.40	680		
27 Mette's Yellow Eckendorfer.....	3.41	2.41	20.23	674		
28 Keith's Prize Taker.....	2.60	2.09	20.18	673		
29 Yellow Leviathan (Bruce).....	2.38	4.56	19.89	663		
30 Bruce's Gate Post Mammoth Long Red.....	2.61	4.29	19.67	656		
31 Simmer's Mammoth Prize Long Red.....	2.89	4.40	19.62	654		
32 Vaughan's Giant Eckendorfer.....	3.52	2.34	19.59	653		
33 Kirsche's Ideal.....	3.49	2.82	19.16	639		
34 Svalof's Rubra.....	2.48	2.63	18.74	625		
35 Cooper's New Golden King.....	2.38	2.20	18.10	603		
36 Dippe's Golden Tankard.....	2.54	2.63	16.68	556		
37 Garton's Golden Tankard.....	2.54	2.82	16.62	554		

In studying the foregoing table it is interesting to note that the long, the intermediate, and the tankard classes of roots are represented by varieties which are amongst the highest yielders and are also represented by other varieties which are amongst the lowest yielders of the different kinds here reported. The Ideal, which stands second on the list in yield of roots per acre, is a tankard mangel, the seed of which has been grown in Ontario. This, I understand, is practically the same variety as the Kirsche's Ideal, the seed of which was grown in Germany. The difference in the yield per acre, which varies from 639 to 799 bushels per

acre, is apparently due largely to the fact of the quality of the seed. The home grown seed has given decidedly better results than that produced in Germany. This is probably one of the most interesting and one of the most important lessons which can be obtained from the tabulated results here presented. The Yellow Leviathan mangel which comes tenth on the list was produced from seed grown at the College. Unfortunately, in 1912 the seed produced at the College was exceptionally poor in germination. This may have been due to the fact that in that year there was a very early frost, which occurred before any of the mangel seed had been gathered. In most of the years since 1906 the College-grown seed of the Yellow Leviathan mangel has surpassed in germination and productivity the seed of the same variety which has been imported. It is interesting to note that the Yellow Leviathan mangel obtained from different sources has given results which vary to the extent of 110 bushels of mangels per acre. The Yellow Leviathan mangel has made a high record at the College and in the co-operative experiments throughout Ontario in the production of roots within the past nineteen years. It is to be hoped that the seedsmen of Ontario will be able to furnish the farmers of the Province with true seed of this most important variety which will give a high percentage of germination.

VARIETIES OF SUGAR BEETS AND SUGAR MANGELS.

On the average, mangels contain 5 per cent., sugar mangels about 10 per cent., and sugar beets about 15 per cent. of sugar. These percentages vary somewhat according to variety, and also according to the quality of the soil, the date of planting, the method of cultivation, etc. The sugar beets are grown in Ontario for the production of sugar in the vicinities of the sugar beet factories at Berlin and Wallaceburg, and to a limited extent in a few other districts. The sugar mangels, however, are grown more or less in various parts of the Province for the production of feed for farm stock. In 1914 there were 18,534 acres of sugar beets grown in Ontario.

In 1914 twenty varieties of sugar beets and sugar mangels were under experiment in the trial grounds at the College. The following table gives the average results in tons of roots per acre of each of sixteen which have been grown for a period of six years:

Varieties.	Length.		Yield per Acre. 6 Years.
	Above Ground.	Below Ground.	
Tankard Cream	ins.	ins.	tons.
Bruce's Giant White Feeding	4.1	5.6	24.56
Rennie's Jumbo	4.0	5.8	24.22
Keith's Prize Winning Half Sugar	4.0	5.2	23.27
Steele, Briggs Giant White	3.4	5.8	23.18
Rennie's Giant Half Sugar White	4.0	5.4	22.93
Rennie's Giant Sugar	4.1	5.3	22.92
Bruce's Giant Rose Feeding	3.4	6.0	20.05
Rennie's Danish Improved	3.6	6.3	19.71
Simmers' Imperial Giant Half Sugar	3.1	6.0	19.62
Darch & Hunter's Colossal White	.3	6.1	19.62
Royal Giant (Steele, Briggs)	2.0	5.8	19.42
Rennie's Leviathan	3.5	5.9	19.00
Simmers' Improved Imperial	3.0	5.1	18.40
Kleinwanzlebener	1.7	6.5	18.03
Simmers' White Silesian	.7	6.9	14.75
	.8	6.8	13.85

The tabulated results show that there was a variation in the average yield of roots per acre from 13.85 to 24.56, according to variety. The percentage of sugar was determined in a number of the varieties of sugar beets and sugar mangels previous to 1914, and it was found that on the average the percentage of sugar contained in each of those varieties, which are included in the list here presented, was as follows: Tankard Cream, 8.6; Bruce's Giant White Feeding, 8.1; Rennie's Giant Sugar, 10.3; Bruce's Giant Rose Feeding, 13.0; Rennie's Danish Improved, 11.1; Simmers' Imperial Giant Half Sugar, 10.6; Royal Giant, 10.2; Simmers' Improved Imperial, 16.8; and Simmers' White Silesian, 13.7. The Kleinwanzlebener is a sugar beet which has been grown extensively in Ontario and in the United States for sugar production. The percentage of sugar in this variety usually averages about sixteen, and sometimes reaches as high as seventeen and eighteen per cent.

Six varieties of sugar beets and sugar mangels have been grown at the College under uniform conditions in each of fifteen years. The following gives the average yields in tons of roots per acre per annum for the fifteen-year period: Giant White Feeding, 25.6 tons; Royal Giant, 22.0 tons; Giant Rose Feeding, 21.8 tons; New Danish Improved, 21.7 tons; White Silesian, 18.3 tons; and Improved Imperial, 16.7 tons.

In 1914 the highest yields per acre were obtained from the following varieties: Rennie's Giant Half Sugar White, 25.6 tons; Tankard Cream and Bruce's Giant White Feeding, each 24.8 tons; Rennie's Jumbo and Steele, Briggs' Giant White, each 24.3 tons; Keith's Prize Winning Half Sugar, 24.2 tons; Mette's Half Sugar Feeding, 23.3 tons; Simmers' Dairy Queen, 23.1 tons; Darch & Hunter's Colossal White, 21.6 tons; and Rennie's Leviathan, 20.5 tons. All other varieties gave a yield of less than twenty tons of roots per acre.

VARIETIES OF SWEDE TURNIPS.

According to information just to hand there were 95,371 acres of turnips grown in Ontario in 1914. This was the smallest acreage used for the turnip crop in Ontario within the past thirty-three years. The highest acreage during that period was in 1900, when there were 156,583 acres of turnips grown in the Province. In securing the information in regard to the acreage devoted to turnips in Ontario no separation has been made between the swede turnips and the fall or soft varieties. The average yield of turnips throughout Ontario in 1914 was 486; in 1913, 429; and for the past thirty-three years, 432 bushels per acre. In 1914 twenty-five varieties of swede turnips were grown at the College. Of this number twenty varieties have been grown for four years in succession, and the following table gives the average results of each of these varieties for the **four-year period**:

Varieties.	Weight per Root. 4 yrs.	Yield of Tops per Acre. 4 yrs.	Yield of Roots per Acre.	
			1914.	4 yrs. 1911-14.
Garton's Model	1.88	8.10	27.40	21.09
Garton's Keepwell	1.83	7.02	26.65	20.64
Bruce's Giant King	1.80	6.10	28.10	20.39
Shepherd-Pajbjerg (Hartmann's)	1.82	7.13	26.70	20.35
Garton's Superlative	1.71	5.56	26.25	19.68
American Purple Top (Ferry)	1.71	6.02	26.20	19.42
Sutton's Magnum Bonum	1.75	7.54	25.60	19.12
Good Luck (Steele, Briggs)	1.75	7.93	24.36	18.72
Garton's Victory	1.74	7.16	22.65	18.56
Bangholm-Pajbjerg (Hartmann's)	1.68	7.37	25.40	18.56
Garton's Monarch	1.68	7.47	21.40	18.55
Canadian Gem (Darch & Hunter)	1.63	7.07	20.40	18.38
Carter's Prize Winner	1.68	7.73	23.00	18.19
Hartley's Bronze Top	1.63	7.54	24.25	18.03
Perfection White (Steele, Briggs)	1.67	7.01	25.25	17.57
Improved Hall's Westbury (J. A. Bruce)	1.61	5.95	24.75	17.52
Simmers' Defiance	1.58	6.61	23.00	17.38
Carter's Invicta	1.58	7.58	22.50	17.23
Excelsior (Darch & Hunter)	1.67	7.55	21.20	16.72
Garton's Pioneer	1.49	7.79	22.50	16.24

It will be seen that four varieties gave an average of over twenty tons of roots per acre in the average of the four-year period and that two varieties gave an average of less than seventeen tons per acre for the same period. The Hall's Westbury and the Hartley's Bronze Top, two old standard varieties, occupy a comparatively low position in the average yield of roots per acre. Some of the highest producers are comparatively new varieties. The Garton's Model, which gave the highest average yield per acre for four years, came second in yield per acre in 1914. The Garton's Model is a bronze turnip, almost round, and of excellent quality. In examining the turnips for shipping quality in each of the past four years, those varieties which have made the highest score are given in the following list in the order of perfection: Garton's Model and Steele, Briggs' Good Luck, equal; Garton's Keepwell; Garton's Superlative; Sutton's Magnum Bonum; and Bruce's Giant King.

Eight varieties of swede turnips have been grown under experiment at the College in each of eight years. The results for this period show that the yield of roots per acre per annum the following varieties have made the highest records: Garton's Keepwell, 20.8 tons; Carter's Prize Winner, 19.1 tons; Good Luck, 19 tons; and Carter's Invicta, 18.6 tons. It will be seen that the Carter's Invicta, which gave exceptionally good results a few years ago, has been much less productive during the last three or four years. This is also true to a certain extent of the Carter's Prize Winner variety.

VARIETIES OF FALL TURNIPS.

The acreage devoted to fall turnips in Ontario is quite limited. Although this class of roots will usually yield more per acre than the swede turnips they do not keep so late into the winter, owing to their inferior keeping qualities. The fall turnips are sometimes called soft turnips or white fleshed turnips. Four varieties of fall turnips were grown in 1914 and the following yields in tons per acre were produced: Sutton's Purple Top Mammoth, 38 tons; Sutton's Imperial

Green Globe, 33.3 tons; Red Top White Globe, 32.8 tons; and Cow Horn, 28.5 tons. These results are somewhat different from the average results for a number of years, as for instance, the same four varieties have been under test for seven years and the average yields in tons per acre per annum for the full period have been as follows: Red Top White Globe, 28.1 tons; Sutton's Purple Top Mammoth, 27.8 tons; Sutton's Imperial Green Globe, 25.7 tons; and Cow Horn, 22.6 tons. The Red Top White Globe has given an average of 27 tons and the Cow Horn an average of 20.6 tons in the average yield of roots per acre in tests of these two varieties extending over a period of thirteen years.

VARIETIES OF FIELD CARROTS.

In 1898 no less than 12,418 acres were used for the growing of field carrots in Ontario. In 1914 the number of acres used for the carrot crop in the Province was only 2,448, while the average for the last thirty-three years has been 8,360



New Building for the Department of Field Husbandry shown in the centre of the picture.

acres per annum. It will, therefore, be seen that the carrot crop is at present quite insignificant in comparison with that of a few years ago. There were in all 167 acres of carrots grown in Simcoe County in 1914. This is the only county in Ontario in which there were more than one hundred acres of carrots. In 1914 seven different varieties of carrots were grown in our experimental plots for the fifth time in succession. These varieties gave the following average yields per acre per annum for the five-year period: Simmers' Improved Giant Short White, 25.6 tons; Bruce's Mammoth Intermediate Smooth White and Steele's Improved Short White, each 25.4 tons; Rennie's Mammoth Short White, 25.1 tons; Steele's, Briggs' Large White Belgian, 22.9 tons; Keith's Improved White Intermediate, 22.4 tons; and Carter's Gate Post Orange Long, 20.9 tons.

Five varieties of field carrots have been tested under similar conditions in each of fifteen years. The following table gives the average yield in tons per acre per annum of each of the five varieties of carrots for the fifteen year period:

Varieties.	Color.	Length of Roots.	Yield per Acre.
		ins.	tons.
Bruce's Mammoth Intermediate Smooth White.....	White	8.4	27.8
Steele, Briggs' Improved Short White	White	8.5	27.8
Simmers' Improved Giant Short White.....	White	8.3	26.9
Large White Belgian	White	10.9	24.5
Carter's Gate Post Orange Long.....	Yellow	8.9	22.5

Bruce's Mammoth Intermediate Smooth White, which gave 31.9 tons of carrots per acre in 1914, stands at the top of the list along with the Steele, Briggs' Improved Short White, in the average yield of carrots per acre for the fifteen-year period. It might be stated that the carrots of the three highest yielding varieties mentioned in the table are very similar in size, shape and appearance. These are all well-formed, tapering roots, which yield well and are an excellent form of a carrot to grow. Before the introduction of this type of carrot the Large White Belgian was grown quite extensively in Ontario. This variety, however, produces long, slender carrots, which are very difficult to harvest and which give a lighter yield of roots per acre.

VARIETIES OF KOHL RABI.

In Europe kohlrabi is grown much more extensively than it is in Ontario. The kohlrabi plants resemble cabbage in their development and swede turnips in the appearance of their leaves. The valuable part grows about three inches above ground in the form of a bulb. These bulbs are used as a vegetable for the table or as feed for farm stock. When grown as stock feed they may be pastured in the field, with sheep, or harvested and stored for winter feed somewhat similar to mangels and turnips.

In order to secure information as to the value of this crop in Ontario a number of varieties of kohlrabi were formerly grown in our experimental grounds. After these had been carefully tested the number of varieties was reduced to three. Each of these three varieties have now been grown under test for thirteen years, and the average yields in tons of roots per acre per annum have been as follows: Earliest Erfurt, 16.5 tons; Early White Vienna, 16.3 tons; and Goliath Purple, 14.5 tons. It will, therefore, be seen that none of these varieties of kohlrabi equal in yield per acre the leading varieties of mangels, turnips or carrots in the experiments conducted in Ontario.

VARIETIES OF PARSNIPS.

Although parsnips have not been grown in Ontario to any great extent as a feed for farm stock, enquiries have been made and discussions have been carried on in regard to the advisability of growing parsnips in Ontario as a field crop. Several varieties were tested at the College, but each of these has been dropped from the test with the exception of two kinds which have now been grown for twelve years in succession, and one variety which has been grown in each of the past two years. The New Ideal Hollow Crown variety gave an average of 8.34 and the Sutton's Cattle variety of parsnips an average of 8.27 tons of roots per acre per annum in the twelve-year period. It will, therefore, be seen that these two varieties have practically equal results. Parsnip seed produced by the Ontario Seed Co., Waterloo, Ontario, was secured in the spring of each of the past two years. This variety gave 6.7 tons per acre in 1913, and 9.4 tons per acre

in 1914. It will, therefore, be seen that the parsnips have not produced as large a yield per acre as the kohlrabi, which in its turn gave a lower yield per acre than the other classes of field roots grown in Ontario.

THE PRODUCTION OF FIELD ROOT SEED IN ONTARIO.

About one million pounds of seed of field roots is required in Ontario annually. The probable amount of each class of roots required in 1915 may be approximately estimated as follows: Turnip seed, 300,000 pounds; Carrot seed, 10,000 pounds; Mangel seed, 350,000 pounds; and Sugar Beet seed, 250,000 pounds. In recent years the root seed has been mainly obtained from the following sources: Mangel seed largely from France, with smaller quantities from England and from Germany; Sugar Beet seed from Germany and from the United States; and Turnip seed principally from England. The Canadian-grown seed of the field roots has been exceedingly small. It will be seen that a large percentage of the root seed is obtained annually from those countries which are at war at the present time. Just what influence the unsettled conditions in Europe will have on root seed production is unknown. It is well for us at this particular time to consider the advisability of giving more attention to the production of root seed in this country.

During the last nine years experiments have been conducted at the Ontario Agricultural College with mangels, turnips and carrots for seed production. As varieties of these different crops naturally cross-fertilize we have confined our attention to one variety of each class. The experiments have been confined largely to the storing of the mother roots in the winter; the planting of the mother roots in the autumn and in the spring; the yield of seed; the improvement of the variety by the selection of roots and of the seeded plants; the germination of home-grown seed; and the yield per acre from home-grown as compared with imported seed.

In each of seven years mother roots of mangels, carrots and swede turnips have been stored in three different ways, viz., in loose piles in a cool root cellar; in sand in a cool root cellar; and in pits in the field. The results would seem to indicate that if a farmer wishes to grow a small quantity of root seed the mother plants may be stored in a cool cellar to good advantage. If the object, however, is to grow root seed in a commercial way, the mother plants can probably be kept through the winter in the best condition in properly constructed and well-ventilated pits. Any one of the three methods here indicated, however, might be used satisfactorily. There was the least amount of decay from the mangels which were stored loosely in the cellar, and from the carrots and swede turnips which were stored in the sand. The roots which were stored in the sand were exceptionally free from mould and were about equal in firmness to the roots which were stored in the pits. The mangels and the carrots gave the greatest percentage of sprout in the spring when stored in the pits, and the turnips when stored in the sand. It should be understood that the roots in all cases were of ordinary size, and were not in the form of stecklinge as frequently used in the production of root seed for commercial purposes.

In some of the warmer countries the roots are allowed to remain in the land throughout the winter, especially by a slight protection of soil. In the colder climates, however, it is the usual custom to store the roots over winter and to plant them in the field in the spring. Some interesting experiments have been conducted at the College in a comparison of autumn and spring planting of the

mother roots. For the autumn planting the land is slightly trenched with the plough about the first week in November, and the roots are planted three feet apart in the rows, the rows being about five feet apart. The roots after being placed are covered with loose, dry straw, after which they are covered with the plough by turning two furrows on each side of each row. After the land has become slightly frozen, usually about the middle of December, strawy manure to the depth of three or four inches is placed over the ridges. In the spring when danger of severe frost is over, the manure and the surface soil is removed from over the roots. This usually takes place early in May. Our experience has been that when roots are planted in this way they will give a considerably larger yield of seed in comparison with similar roots which are planted in the spring when the danger of frost is past.

For commercial purposes the plants are usually cut when about two-thirds of the seed has turned brown. The plants are placed in small stooks or stacks and



View of portion of Experimental Grounds, showing experimental plots of potatoes, field roots and corn.

threshed with a dry. In the growing of root seed in a small way the seed may be stripped from the plants, or the plants may be gathered and the seed threshed with an ordinary grain thresher. At the College we usually gather the ripe seed early in September, and later in the month secure the seed which matures at a later date. From observations made it seems very important to collect the seed before it is injured by frost. In 1912 a frost of two degrees was registered before any mangel seed had been gathered. The germination of the seed in that year was exceptionally poor.

Individual plants of mangels, carrots and turnips vary considerably in seed production. As the results of six years' work at the College we have obtained on an average 6.6 ounces per plant from mangel seed obtained from a considerable number of the best plants each year. Our average yield of carrot seed per plant for the same period has been a little less than two ounces, and that of the swede turnips only about four-fifths of an ounce per plant.

In connection with this work throughout it has been the object of selecting mother roots uniform in size, shape and color, and of good quality. It has also

been the practice to select some of the choice plants from the standpoint of seed production with the object of securing seed as foundation stock for Ontario, not only of the best variety in each class of crop, but also of such a strain that it will produce good roots, and if required a high yield of seed which will mature as uniformly as possible. We believe we are doing some good work along this line, and we have already distributed some lots of mangel seed as foundation material for the production of seed in Ontario.

The accompanying table deals entirely with what is called the "Yellow Leviathan" mangel as obtained from different sources. In each of the past six years very careful determinations have been made in the field as to the percentage of plants produced from exact numbers of mangel clusters planted under uniform conditions. This has been an extensive experiment made in a definite way to determine the actual percentage value of different lots of mangel seed obtained in different years.

GERMINATION OF MANGEL CLUSTERS.

Years.	Ontario Agricultural College.	Steele, Briggs Seed Co.	D. M. Ferry & Co.	Hewer Seed Co.	Wm. Rennie Co.
1909	142	85	84	68	41
1910	90	96	101	101	85
1911	137	116	129	138	61
1912	27	46	55	55	55
1913	137	59	65	66	73
1914	55	127	85	68	119
Average 6 years	98	88	87	83	72

In order to get the germination of the mangel seed thirteen separate tests were made in the six year period by using uniform numbers of clusters of mangel seed in each test with each different lot of seed. It will be seen that the germination in 1912 was exceptionally low. This was particularly true in regard to the seed produced in Ontario owing probably to a frost which occurred before the seed was collected. It will be seen that the Ontario mangel seed gave a particularly high percentage of germination in 1909, 1911, and 1913, and a comparatively low percentage of germination in 1912 and 1914. In the average of the six years, however, the Yellow Leviathan mangel seed produced at the College gave a higher percentage of germination than that obtained from any other source. It will be seen from the results here presented that Ontario grown mangel seed has made a comparatively high record in germination.

VARIETIES OF CORN FOR THE SILO AND FOR FODDER.

We learn from the report of the Bureau of Industries for Ontario that the acreage devoted to husking corn is slightly decreasing from year to year, while that used for corn for the silo is gradually increasing. The number of acres used for husking corn was 299,871 in 1913, and 290,817 in 1914, and the number of acres used for silo corn was 388,138 in 1913, and 418,105 in 1914. Those counties having the greatest number of acres for fodder corn in 1914 were as follows: Oxford, 30,684 acres; Middlesex, 22,136 acres; Huron, 17,836 acres; Carleton, 16,322 acres; York, 16,233 acres; Perth, 16,173 acres; and Lambton, 16,614 acres. The area used for the growing of fodder corn in Ontario has been more

than doubled within the past eight years. These figures go to show that fodder corn is becoming a particularly important crop in Ontario and that this importance increases from year to year. It is interesting to know that this increase has been made in spite of the scarcity of labor in Ontario and at a time when nearly all classes of field roots have been decreasing in acreage.

It is certainly true that no one variety of fodder corn is suitable for all parts of the Province. Owing to the importance of the crop in Ontario extensive experiments have been conducted, the results of which might form a general guide for the farmers in different sections of the Province. A large number of varieties have been planted in duplicate plots in the experimental grounds in each of the past few years. The results are reported in such a way that they should form valuable information to any one interested in corn growing in the Province of Ontario, whether he be located in Wellington County, in Essex, in Glengarry, in Welland, or in Parry Sound, or in any other county of the Province. This may seem strange to the reader at first thought, but those familiar with our methods of experimenting and the way in which the results are presented acknowledge the truth of the statement here made. In co-operation with the experimental work here at the College it is also important that each farmer do a certain amount of experimental work for himself and in this work we are in a position to assist him considerably. It is well for each person to make a careful study of the results of the experiments which have been conducted at the Provincial experiment grounds as a basis for his work. From the results presented he is able to glean information in regard to the total yield per acre, yield of ears, stage of maturity, etc. The requirements of the various localities are so different that it seems necessary to give results which can be studied by individual farmers in order that the greatest value from the experiment can be obtained. We therefore present the average of five years' experiments of each of forty-three varieties of corn which have been grown under uniform conditions. It should be remembered that each test is conducted in duplicate and therefore the results presented are the average of ten distinct tests made in the five year period. It should also be remembered that a large number of varieties which have given only medium results have been already discarded from the list. In the experimental work the corn has usually been planted during the last ten days of May, and it has generally been harvested about the middle of September. Immediately after the corn has been cut the weight of the whole crop has been taken after which the ears have been harvested, counted, weighed and examined. The stage of maturity of the corn has been indicated by the condition of the grain at the time it was harvested. The seven terms which have been used to describe the corn in regard to its ripeness have been as follows: Water, Early Milk, Milk, Late Milk, Dough, Firm Dough, and Ripe.

Not only is it important to test the distinct varieties, but much depends upon the source of the seed of each individual variety. We present in the results in a general table the record of the White Cap Yellow Dent corn obtained from five different sources in Ontario, and in a separate table those of the Longfellow and the Compton's Early varieties obtained from Ontario and from the United States.

Fodder Corn Table No. 1 gives the average of the five years' experiments with each of forty-three varieties and strains of corn and the list is arranged according to the total yield of green crop per acre, including the stalks and leaves and the ears. Corn Table No. 2 gives the detailed results for ten years of the Longfellow and the Compton's Early varieties of corn, the seed of which was obtained from Ontario and also from the United States.

FODDER CORN TABLE NO. 1.

Varieties.	Description of Varieties.	Class of Corn and Color of Grain.	Average number of rows per Ear, 5 years.	Condition of Grain when harvested.	Average Results of Five Years' Experiments, 1910-14.					
					Number of days until full tasselled.	Height of Plants.	Weight per Ear.	Husked Ears.	Total Crop Green.	Yield per Acre.
						ins.	lbs.	tons.	tons.	
1. Eureka	Yellow Dent..	16-18	Early Milk..	99	112	6.72	2.58	20.67		
2. Salzer's North Dakota..	White Flint..	8	Dough	89	93	6.17	3.51	18.97		
3. Reid's Yellow Dent	Yellow Dent..	18	Early Milk..	94	108	6.03	2.72	17.84		
4. Mammoth Southern Sweet	White Dent..	14	Early Milk..	98	103	5.62	2.18	17.82		
5. Gold Nugget	Yellow Flint..	8	Firm Dough	84	94	8.20	3.82	16.95		
6. Improved Leaming (Vick)	Yellow Dent..	18	Milk	91	104	8.52	3.61	16.26		
7. White Cap Yellow Dent (H. Smith)	Yellow Dent..	16	Late Milk..	89	102	8.99	3.70	16.37		
8. Silver Triumph	White Flint..	8	Firm Dough	85	90	6.37	3.36	16.22		
9. Early Butler	Yellow Dent..	16	Late Milk..	90	104	7.73	3.44	16.03		
10. Genesee Valley	Yellow Flint..	8	Firm Dough	82	86	6.15	3.15	15.86		
11. Rennie's xxx Early Sweet	Sweet	12	1 to Milk..	87	79	7.73	4.03	15.85		
12. Hoopengardner's Very Early Yellow Dent	Yellow Dent..	16-18	Milk	89	102	8.47	3.76	15.84		
13. Stowell's Evergreen	Sweet	14-16	Milk	93	88	7.09	2.89	15.82		
14. Wisconsin No. 7	White Dent..	16	Late Milk..	87	94	7.92	3.49	15.59		
15. Simmers' Mammoth Eight-rowed	Yellow Flint..	8	Firm Dough	84	87	5.71	3.08	15.56		
16. Sanford	White Flint..	8	Dough	84	89	6.73	3.26	15.25		
17. Canada Yellow	Yellow Flint..	8-12	Firm Dough	84	86	6.44	3.19	15.23		
18. Compton's Early (Duke) ..	Yellow Flint..	12	Firm Dough	85	88	7.09	3.54	15.10		
19. Longfellow (Duke)	Yellow Flint..	8	Firm Dough	81	87	6.39	3.12	15.00		
20. Duke's Improved Sweet ..	Sweet	14	Milk	93	90	7.25	3.12	15.03		
21. 90-day Red Flint	Colored Flint..	8	Firm Dough	82	87	6.81	3.54	15.02		
22. Australian Extra Early Eight-rowed White	White Flint..	10-12	Firm Dough	83	90	7.09	3.62	14.94		
23. White Cap Yellow Dent (E. M. Zavitz)	Yellow Dent..	14	Dough	84	98	8.41	3.70	14.87		
24. White Cap Yellow Dent (Thomas)	Yellow Dent..	12-14	Dough	85	94	7.66	3.46	14.65		
25. King Phillip (Duke)	Colored Flint..	8	Firm Dough	81	89	6.44	3.11	14.23		
26. Red Blazed	Colored Flint..	8	Firm Dough	81	89	6.91	3.15	14.15		
27. Golden Glow or Wisconsin No. 12	Yellow Dent..	16	Dough	83	93	8.12	3.82	14.07		
28. Wisconsin No. 8	Yellow Dent..	16	Dough	84	93	7.88	3.70	13.84		
29. Squaw Corn	Colored Flint..	8-12	Ripe	82	87	6.72	3.30	13.47		
30. White Cap Yellow Dent (Dawson)	Yellow Dent..	14	Late Milk..	87	99	7.71	3.09	13.44		
31. Duke's Improved Early White Cap	Yellow Dent..	8-12	Dough	82	89	7.42	3.08	13.33		
32. Early California Flint ..	Yellow Dent..	12	Ripe	81	85	7.37	3.60	13.26		
33. Northwestern Dent	Colored Dent..	12-14	Firm Dough	82	86	7.77	3.41	12.96		
34. Sterling White Dent	White Dent..	14	Dough	85	89	7.33	3.07	12.83		
35. Leaming (Duke)	Yellow Dent..	16	Milk	92	99	8.50	2.64	12.81		
36. University No. 13	Yellow Dent..	16	Firm	91	99	7.55	3.58	12.78		
37. Early Strawberry (Martene)	Colored Dent..	12	F							
38. White Cap Yellow Dent (Hammond)	Yellow Dent..	14					25.12			
39. Early Colorado Dent	Yellow Dent..	12					12.06			
40. Simmers' Earliest Ripe ..	White Dent..	12					3.18	11.83		
41. Mammoth White Cory ..	Sweet	8-10	Do			3.76	3.54	11.45		
42. Pearce's Early Evergreen.	Sweet	12-14	L			6.99	3.83	11.18		
43. Golden Bantam	Sweet	8	F	79	58	3.71	2.57	8.05		

CORN—TABLE No. 2.

Average Results for Ten Years.	Longfellow.		Compton's Early.	
	Ontario.	United States.	Ontario.	United States.
Number of days until in full tassel	81	87	85	86
Height of plants (Inches)	92	94	96	97

CORN—TABLE No. 3.

Year.	Yield of Grain per Acre. Bushels by Weight.				Total Yield of Green Crop per Acre. Tons.			
	Longfellow.		Compton's Early.		Longfellow.		Compton's Early.	
	Ontario.	United States.	Ontario.	United States.	Ontario.	United States.	Ontario.	United States.
1905	71.9	52.0	70.8	55.2	19.9	23.1	22.1	22.0
1906	84.9	79.0	73.5	38.4	14.6	16.3	15.8	16.8
1907	51.8	33.9	50.0	38.4	20.5	18.1	22.6	18.7
1908	61.2	55.8	63.4	50.0	13.7	16.0	16.9	16.5
1909	36.9	27.4	31.9	29.2	15.8	17.7	15.6	15.5
1910	47.3	34.5	43.0	51.4	17.0	17.9	16.0	15.6
1911	31.8	30.7	42.0	41.1	11.8	17.6	16.2	16.3
1912	21.5	11.1	23.6	18.6	17.5	19.9	17.4	19.9
1913	45.0	22.6	41.6	34.7	13.6	15.4	12.4	16.8
1914	46.0	27.8	37.7	38.3	15.6	16.2	13.4	16.0
Average for 10 Years	49.1	37.5	47.8	44.5	16.0	17.8	16.8	17.4

The results here indicated are exceedingly interesting. If a man in Glen-garry County has been growing the Canada Yellow Corn, he might, through a study of the table, ascertain the fact that the Gold Nugget, which matures at practically the same time, has given an average of about one and three-quarter tons of total crop per acre and upwards of one-half ton of ears per acre more than the first named variety when tested at the College under uniform conditions. This would suggest to him the advisability of his trying the Gold Nugget variety in comparison with the Canada Yellow, and it might be possible that the College results would thus enable him to grow on his own farm a more suitable variety to meet his own local conditions. Another farmer, who has been growing the Dawson strain of the White Cap Yellow Dent corn would be able to realize that the Wisconsin No. 7 which matures at practically the same time would be likely to give him two tons per acre more of total crop, or that the Smith's Strain of White Cap Yellow Dent which also reached the late milk condition in the College tests might give him about three tons per acre more of total crop as well as an increase of about three-quarters of a ton of ears per acre. In many other ways a man is able to study the tabulated results with much profit to himself, and for information which would be of real service as suggesting better varieties for his home conditions.

Many people imagine that the dent corns are heavy producers and rather late in maturing, and that the flint varieties are light producers and rather early in

maturing. A study of the table, however, will show that there are marked exceptions to this rule. It will be seen that the second highest yielding variety of corn in the average of the five years' results is a flint and that the fourth lowest yielding variety is a dent. There are eight dent varieties which have given a lower average yield of total crop per acre than the lowest flint variety which is recorded. It will be noticed that the Salzer's North Dakota White Flint corn produced 3.5 tons of ears and practically 19 tons of green crop per acre, while the Simmers' Earliest Ripe White Dent corn produced 3.2 tons of ears and only 11.8 tons of total crop per acre, and each of these varieties were on the average in the dough condition at the time when they were harvested. It will be noticed that there are only four varieties of corn in the list which we have indicated as perfectly ripe. Probably what we term "firm dough" would generally be spoken of as ripe by many farmers.

It is exceedingly important to note the fact that there is not only a marked difference in the varieties, but also that there is a decided variation in the results of some varieties obtained from different sources. Certain farmers who have grown the same varieties for a number of years and have been selecting ears according to their own ideas have gradually changed these corns until we have quite distinct strains under the same variety name. In connection with this consideration the attention of the reader is directed to the results obtained from the White Cap Yellow Dent secured from five different sources and reported in the first table. The White Cap Yellow Dent obtained from H. Smith of Essex County, is seventh on the list, and that obtained from J. Hammond, also from Essex County, is thirty-eighth on the list in the average yield of total crop per acre. The average yield of ears per acre amounted to 3.7 tons in the case of the White Cap Yellow Dent corn obtained from E. M. Zavitz in Middlesex County, and 3.1 tons per acre from A. Dawson of Essex County. These differences have been brought about evidently by the influence of the selections made by the respective growers, each man selecting according to his own ideal. It is, therefore, important in ordering corn not only to know the variety, but to know something of the source of the seed and the particular strain of corn which is being secured.

Corn Tables No. 2 and No. 3 present a comparison between home grown seed and seed which has been grown farther south in the United States, as illustrated by the results of the Longfellow and the Compton's Early varieties of corn in a series of experiments extending over a period of ten years. It might be stated that the Ontario grown seed was produced in Essex county, but it is not known in what part of the United States the Longfellow and the Compton's Early varieties were grown, as these lots were obtained through the seed trade. It is interesting to note that there is a very marked difference in the crops produced from seed obtained from Ontario and the American seed. Without a single exception the Longfellow corn grown from Ontario seed produced a greater yield of grain per acre and with only one exception a lighter yield of total crop per acre than the crop produced from the seed grown in the United States. The average results for the ten years show that the Ontario grown seed surpassed the American seed by 11.3 bushels of grain per acre per annum, and that the American surpassed the Ontario seed in the production of total crop by 1.8 tons of green crop per acre per annum. The Compton's Early variety shows results somewhat similar, but the differences are not quite as marked as those of the Longfellow.

For growing corn for the silo or for fodder it is, therefore, of great importance to know something of the source of seed and of the different strains as well as the peculiarities of the varieties, if the best results are to be obtained.

VARIETIES OF SORGHUM FOR FODDER.

Although sorghums are not grown as extensively in Ontario as they are in some the States of the American Union, their cultivation is becoming more prominent in a few sections of the Province. Under the term "sorghum" is included a number of different classes of crops such as sugar cane, broom corn, kaffir corn, milo maize, etc. Those varieties of sorghum spoken of as sugar canes in seedsmen's catalogues, but which are more correctly named sugar sorghums are used for fodder purposes in Ontario more than any of the other classes of sorghums. The best results from the sorghums may be expected from rich sandy loams. As a rule the sorghums thrive well in comparatively dry seasons. Experiments have been conducted at Guelph in testing different varieties of sorghums not only for seed production, but also from the standpoint of production of green fodder. For the production of fodder the crop is usually sown the latter part of May or very early in June either in rows or in squares somewhat similar to corn, although the plants are usually left a little closer together. Besides the production of fodder sorghum may be used for pasture purposes. The Early Amber sorghum has been used quite extensively in a pasture mixture in experiments at the College, the results of which will be referred to in the latter part of this bulletin. For the production of fodder ten varieties of sorghum were under experiment at the College in 1914. Of this number, seven varieties have been grown under similar conditions in each of fifteen years. Previous to 1912 the seed was planted in squares twenty-seven inches apart each way and three plants were allowed to remain in each place. The seed was planted to a depth of about three-quarters of an inch. In 1912 a change was made in the method of planting, by the seed being placed in rows twenty-six inches apart and ten inches apart in the rows. One plant was allowed to remain in each place. In each year the sorghum received cultivation throughout as required. The experiment was conducted in duplicate in the past season. The following table gives the average results of each of seven varieties for 1914 and also the average results for the past fifteen years:

VARIETIES OF SORGHUM.

Varieties.	Height.		Yield of heads per acre.		Total yield per acre.	
	1914.	Average 15 years. 1900-1914.	1914.	Average 15 years. 1900-1914.	1914.	Average 15 years. 1900-1914.
	ins.	ins.	tons.	tons.	tons.	tons.
Orange Sugar Cane.....	95	90	.60	.36	20.90	17.81
Early Minnesota Sugar Cane.....	102	105	1.78	.84	17.10	17.03
Early Amber Sugar Cane.....	106	96	1.31	.97	18.70	15.40
White Kaffir Corn.....	76	68	.75	.63	17.85	12.47
California Golden Broom Corn.....	102	109	2.16	1.47	10.35	10.31
Early Japanese Broom Corn.....	118	107	1.29	1.42	13.35	10.45
Improved Evergreen Broom Corn..	101	106	2.20	1.35	10.45	9.46

That sorghum can be grown successfully in Ontario is shown by the accompanying table. The Orange Sorghum gave 20.9 tons of green crop per acre in 1914, and 17.8 tons per acre in the average of fifteen years. This variety, however, is later and in that way not as suitable as either the Early Minnesota Sorghum or the Early Amber variety, each of which is satisfactory for growing as a fodder

crop in a good many sections in Ontario. The highest producers amongst the sorghums gave greater yields per acre than about two-thirds of the varieties of corn, as will be seen by referring to the corn experiments. It will be seen that the Early Amber produced a greater yield of heads per acre than any other variety of sorghum, the yield being almost three times as great as that of the Orange Sorghum. Of the three varieties of sorghum the Early Minnesota produces the tallest plants, the Early Amber the most seed and the Orange the largest amount of green fodder.

In each of the past four years an interesting experiment has been conducted in our experimental grounds to ascertain the comparative value of seed obtained from different plants of the Early Amber Sorghum. In 1911 it was found that there was a decided difference not only in germination, but also in height of plants, in character of growth, in earliness, and in maturity. In 1912 the experiment was repeated with five of the same strains which were used in 1911, and also the seed of twelve additional plants. The results for 1912 showed that there was a variation in yield of crop per acre from 7.5 tons to 13.3 tons of green fodder, and from three-fifths of a ton to one and one-third tons of heads per acre. In 1913 an experiment was conducted by planting the seed from ten distinct plants of sorghum, the seed being collected at three separate dates and under different conditions, and also from ten heads from each of two farms. The results show considerable variations and indicate the fact that we have entered upon an important line of investigation in regard to the improvement of sorghum and the best time to secure the seed for the very best results. In 1914 one hundred and twenty-one selected heads of sorghum were very carefully examined and the largest, ripest and most productive heads were used for a distinct test. The fourteen different lots which were compared in the past season showed a variation in yield of heads per acre from 1.05 tons to 2.55 tons, and of green crop per acre from 10.75 to 15.9 tons. Selections of the best heads from the best plants in the best rows are saved this year for future work.

VARIETIES OF MILLET FOR THE PRODUCTION OF FODDER.

Millet is considered largely as a supplementary crop. It can be sown comparatively late in the season on land on which corn or some of the other crops can not be planted at the proper time. It could also be sown at a season of the year after which time it is known whether or not the ordinary hay crop of the country would prove likely to be above or below the normal. Besides using millets as a supplementary crop some people grow a small amount of millet regularly as an annual crop for the production of hay or of green fodder. As a rule it is wise to sow about twenty-five pounds of seed per acre on land that has been carefully cultivated and that is in a moist condition to assure quick germination. From our experience at Guelph it appears as if there are but few crops the seed of which loses its vitality as quickly as millet seed if sown under unfavorable conditions. If seeding takes place in May or about the first of June a late variety may be sown, but if the seeding does not take place until the latter part of June or in July an early variety is likely to give the best satisfaction.

Twenty-one different varieties and strains of millet were grown for fodder purposes in the experimental grounds in 1914. Of this number seven varieties have been grown in each of nineteen years. Fourteen varieties have been grown at least six years, eighteen varieties for five years, and twenty varieties for four or more years. Of the seven varieties grown for nineteen years the yields of hay

per acre per annum were as follows: Japanese Panicle 4.4 tons; Holy Terror Gold Mine 4.2 tons; Golden Wonder 4.0 tons; Japanese Barnyard 3.5 tons; Hungarian Grass 3.4 tons; German or Golden 3.3 tons; and Common 3.2 tons.

VARIETIES OF MILLET.

Varieties.	Average Dates 5 years. 1910-1914.		Height.		Yield per Acre.			
	Seeding.	Cutting.	1914.	Average 5 years. 1910-1914.	Green Fodder.		Hay.	
					1914.	Average 5 years. 1910-1914.	1914.	Average 5 years. 1910-1914.
			ins.	ins.	tons.	tons.	tons.	tons.
1. Japanese Panicle	June 16	Sept. 15	38	35	12.40	9.58	4.35	4.05
2. Holy Terror Gold Mine	June 16	Sept. 5	29	32	9.05	7.95	3.48	3.36
3. Siberian	June 16	Sept. 2	24	28	9.55	7.60	3.50	3.23
4. Steele Trust	June 16	Sept. 1	29	30	9.50	7.63	3.75	3.23
5. Early Foxtail (Nichi)	June 16	Sept. 3	25	32	7.15	7.08	2.95	3.21
6. Japanese Barnyard	June 16	Sept. 12	43	37	9.10	7.96	3.35	3.17
7. Hungarian Grass	June 16	Sept. 2	26	31	8.45	7.10	3.23	3.13
8. Golden Wonder	June 16	Sept. 3	30	29	9.25	7.31	3.53	3.10
9. German or Golden	June 16	Aug. 31	27	32	7.00	6.58	2.85	2.89
10. Common	June 16	Aug. 30	29	33	7.85	6.67	2.85	2.84
11. Japanese Barnyard (Minami)	June 16	Sept. 10	35	32	6.06	7.33	2.25	2.84

The highest yield in green fodder and of hay per acre in 1914 and in the average yield of green fodder and of hay per acre in the past five years has been made by the Japanese Panicle millet. The Japanese Panicle variety of millet was brought from Japan by Prof. Brooks of the Agriculture College, Amherst, Mass. Prof. Brooks had occupied a position on the staff of an Agricultural College in Japan for seven years previous to his return to the United States. He brought with him three varieties of millet representing three types, viz., Japanese Panicle, Japanese Barnyard and Japanese Common. The Japanese Panicle millet produces plants of an upright growth, a spreading head and a large leaf development. The crop usually stands up well and is highly productive. The seed of the Japanese Panicle millet is smooth, shiny, and of a dark brownish color. In ordering seed of the Japanese Panicle millet from the seedsmen great care should be taken to make the order very distinct or it is quite probable that the Japanese Barnyard variety will be forwarded. In some of the seedsmen's catalogues they have described the Japanese Barnyard millet, and have illustrated the Japanese Panicle variety. Most of the seedsmen, however, have corrected this peculiar error and now have the illustration and the description consistent with each other. The two millets are entirely different in appearance and have produced results which vary considerably, the Japanese Barnyard coming comparatively low on the list and the Japanese Panicle variety at the top of the list in the tabulated results here presented. When a quantity of seed of the Japanese Panicle millet is desired it is wise to obtain a sample and examine it carefully as to variety before ordering a large quantity. The Japanese Panicle and the Japanese Barnyard millets not only represent different varieties but also different species.

DATES OF SOWING MILLET.

In each of six years an experiment was conducted in which the Japanese Panicle and the Japanese Barnyard millets and the Hungarian Grass were sown on May 15th, June 1st, June 15th, July 1st, July 15th, and August 1st. The average results for the whole period show that the highest yields in tons of green crop per acre per annum were obtained in the case of each of the three varieties from the seedings of June 1st. It might be mentioned, however, that for earlier seedings the Japanese Panicle and the Japanese Barnyard varieties are usually the most suitable, but for late seeding the Hungarian Grass, which requires a shorter season for growth, is frequently the most suitable variety to use.

SUNFLOWERS FOR FODDER.

Although the growing of sunflowers for fodder purposes in Ontario was strongly recommended some years ago, they have never been grown except to a very limited extent. In a few instances, however, they have been grown and the heads have been mixed with corn when filling the silo.

Some years ago seven different varieties of sunflowers were tested in an experimental way at the College, but after a few years all were dropped except three kinds. Each of these three varieties have now been under experiment for seventeen years, and the following are the average results per annum in height of plants, yield of heads per acre, and yield of whole crop per acre: Black Giant 105 inches, 6.2 tons, and 21.8 tons; Mammoth Russian 100 inches, 5.7 tons, and 17.7 tons; and White Beauty 89 inches, 5.4 tons, and 16.4 tons. During the past seven years the average yield of whole crop per acre per annum has been as follows: Black Giant 19.8 tons; Mammoth Russian 16.7 tons; and White Beauty 16.5 tons.

VARIETIES OF RAPE, COW CABBAGE, KALE, ETC.

In 1914 there were 42,375 acres used in Ontario for the growing of rape. The Dwarf Essex variety is the one which is used more extensively than all the others combined. The rape plant resembles the swede turnip in its leaf, and the cabbage in its root. It is the leaf and the stem which furnishes the valuable portion for feeding to live stock. Rape makes an excellent late summer and autumn crop for feeding cattle, sheep and lambs, for which purpose it has been used at the College extensively in past years. Lambs have always done exceptionally well when pastured on rape. Their health has been good and their increase in live weight has been rapid. We have conducted a very interesting experiment at the College in which other crops than rape have been included. This experiment has included kale, cow cabbage, sprouting broccoli, and rape, and furnishes some good information in the comparative results when grown in Ontario under similar conditions.

In 1914 twelve varieties belonging to the rape class were under experiment. The crops were all sown in rows 3 1-3 links (26 2-5 inches) apart. Each plot was exactly 1-100 of an acre in size, consisting of three rows each four rods in length. The experiment was conducted in duplicate. The seed was sown on June 25th. The land between the rows was cultivated occasionally throughout the growing season. When the crops had reached their best condition for feeding, each variety was cut with a scythe and weighed immediately.

In England where the cabbages are grown more extensively they are frequently transplanted and a sufficient distance is allowed between the plants to enable the heads to be formed. In our experiments at Guelph, however, we have treated the different kinds of cow cabbage in exactly the same way as we have treated rape.

The heads of the cabbage have been quite small, the growth being practically leaf and stem. The following table gives the results of eleven varieties of rape, kale, cabbage, etc., grown in 1914 and for the average of **six years**:

Varieties.	Height.		Green Fodder Per Acre.	
	1914.	Average 6 Years 1909-1914.	1914.	Average 6 Years 1909-1914.
	ins.	ins.	tons.	tons.
World Beater Cabbage (Darch and Hunter)	17	18	21.15	23.51
Simmers' Early German Brunswick Cabbage	15	15	20.25	23.11
Sutton's Earliest Drumhead Cabbage	16	17	20.95	22.59
Simmers' Matchless Flat Dutch Cabbage	19	17	22.75	22.49
Sutton's Giant Drumhead Cabbage	18	19	21.05	21.05
Sutton's Earliest Sheepfold Cabbage	16	16	20.50	20.50
Cooper's Dwarf Rape (Keith)	22	24	16.95	19.23
Large Seeded Umbrella Rape (Cooper, Taber & Co.) ..	25	26	18.00	19.11
Thousand Headed Kale (Hunter & Co.)	30	28	16.25	17.69
Dwarf Essex Rape (Steele, Briggs)	21	21	13.90	17.17
Sutton's Purple Sprouting Boroccoli	27	25	15.40	16.89

The Dwarf Essex variety of rape has given an average yield of green crop per acre per annum of 17.17 tons. This is a low yield in comparison with some of the other averages given in the tabulated results. The World Beater Cabbage occupies highest place with 23.51 tons per acre per annum. It will be seen that each of six cabbages surpassed every variety of rape, kale, and boroccoli. The yields per acre in 1914 were not very different from the average of the six year period, and in most instances were a little less. The lowest yield in 1914 was that of the Dwarf Essex Rape, 13.9 tons, and the highest yield was that of the Simmers' Matchless Flat Dutch Cabbage, 22.8 tons, per acre. The appearance of the cabbage when growing in the field is very deceiving as it does not grow nearly as tall as the rape and always makes a much higher record at the time of harvest than most people would imagine.

Particular attention should be drawn to the fact that the seed of the different varieties referred to in the tabulated results vary greatly in price. As for instance, the prices of some of the highest yielding varieties according to the seedsmen's catalogues for 1914 were as follows: World Beater Cabbage, \$3.00 per pound; Simmers' Early German Brunswick Cabbage, \$3.00 per pound; and Sutton's Earliest Drumhead Cabbage, \$1.00 per pound. In comparison with these the Dwarf Essex Rape seed could be purchased for 7c. per pound.

Two varieties of cabbage and one variety each of rape, kale, and boroccoli, have been grown in the experimental grounds for a period of fifteen years. The following table gives the average results of the duplicate plots grown in 1914, and also the average of the duplicate tests for the **fifteen year** period:

Varieties.	1914.	Average 15 Years.
	tons.	tons.
Sutton's Earliest Drumhead Cabbage	21.05	23.65
Thousand-headed Kale	16.25	20.81
Sutton's Earliest Sheepfold Cabbage	20.50	20.70
Dwarf Essex Rape	13.90	19.24
Purple Sprouting Boroccoli	15.40	18.76

The results for the fifteen year period are similar to those for the six year period previously discussed with the special exception, however, that the Thousand Headed Kale has given a lower comparative yield per acre within the past two years than it did in the earlier part of the fifteen year period. The Sutton's Earliest Drumhead Cabbage which gave an average of 22.50 tons per acre for the six year period has given an average of 23.65 tons per acre for the longer period of the fifteen year test.

MISCELLANEOUS LEGUMINOUS CROPS FOR GREEN FODDER.

Twenty-one varieties of miscellaneous leguminous crops were grown in the experimental department in 1914 with the object of securing information in regard to the production of green fodder. These included varieties of soy beans, vetches, grass peas, and cow peas. All were sown in rows excepting the grass peas, the hairy vetches, and the common vetches, which were sown broadcast. The highest yields in tons of green crop per acre produced in 1914 were obtained from the following varieties: Hairy Vetches, 10.8 tons; Medium Green Soy Beans, 8.5 tons; Habara Soy Beans, 8.4 tons; Northern Manchurian Soy Beans, 8.3 tons; and Ito San Soja Beans 8.0 tons.

Each of eleven varieties of leguminous crops have been under experiment in each of five years and the accumulated results add to the value of the information. We here present in tabulated form the average results for the **five year** period:

Varieties.	Height.	Yield of Green Fodder per Acre.	
	Average 5 years. 1910-1914.	1914.	Average 5 years. 1910-1914.
	inches.	tons.	tons.
Habara Soy Beans, No. 20405 (Wash.)	24	8.40	7.43
Ito San Soja Beans.....	24	8.00	7.17
Hairy Vetches	26	10.80	7.14
Chernie Soy Beans, No. 18227 (Wash.)	22	5.70	6.70
Early Yellow Soy Beans	21	3.95	5.38
Grass Peas	28	2.00	5.26
Buckshot Soy Beans, No. 17251 (Wash.)	22	5.80	5.24
Common Vetches	14	2.50	4.90
Tsurunoko Soy Beans	22	6.25	4.89
Brown Soy Beans	22	5.75	4.57
Wonderful Cow Peas	14	6.75	4.33

It will be seen that the two highest yielding varieties of leguminous crops in the average results for the five year experiment are soy beans and the two varieties coming second and third lowest from the bottom of the list are also different varieties of soy beans. The one variety of cow peas under experiment has given the lowest average yield of green fodder per acre. The Grass Peas hold an intermediate position. The Hairy Vetches come third from the top and the Common Vetches fourth from the bottom of the list of comparative results.

For **fourteen years** in succession four varieties of leguminous crops have been under experiment and the following table gives the average results in height of crop and in yield of green crop per acre for the whole period:

Varieties.	Height.	Yield per Acre.
	inches.	tons.
Hairy Vetches	29	7.22
Grass Peas	33	6.89
Early Yellow Soy Beans	24	6.31
Wonderful Cow Peas	15	4.87

It is interesting to note that in this short table we have four different classes of leguminous crops represented, viz., vetches, grass peas, soy beans, and cow peas. These are four very good representatives of the different classes. The average results for the fourteen year period show that the hairy vetches have given slightly over seven tons of green crop per acre per annum. The Hairy Vetches which occupy the highest place in the average yield per acre for the fourteen year period are used in Ontario not only as a fodder crop but also as a cover crop for orchards and for this purpose they are spoken of very highly by those who have used them more or less extensively. They have been used in an experimental way at the College for mixing with oats and with common red clover for sowing in the spring of the year to form a pasture crop in the same year in which they are sown, the three varieties forming a natural rotation. Early Amber Sorghum, however, rather surpassed the Hairy Vetches for this purpose.

PASTURE CROPS IN ONTARIO.

We ascertain through a study of the reports of the Bureau of Industries for Ontario that the acreage of pasture in the Province was 2,694,600 acres in 1900. This area was gradually increased from year to year until 1906 when it reached 3,349,101 acres, after which there was a gradual decrease until 1912 when the area amounted to 3,082,671 acres. During the past two years the pasture has increased very rapidly, as we learn that there were 3,120,146 acres in 1913 and 3,302,503 acres in 1914. With the exception of the three years from 1906 to 1908, inclusive, we have now more pasture land in Ontario than at the time when the first Provincial statistics were collected in 1884. Unfortunately, many of the pastures of Ontario consist of old timothy sods. Timothy is not particularly a good pasture grass and yet it is used more extensively than any other variety. I feel sure that farmers generally will agree with me that there are too many old timothy sods in Ontario at the present time. It is probably safe to say that pasture production in Ontario is one of the weakest parts of the agriculture of the Province. We have felt in hopes that the gradual decrease in the amount of pasture in the Province from 1906 to 1912, indicated rather more intensive cultivation. The rapid increase, however, in the last two years seems to indicate that the scarcity of labor is still exerting a marked influence on the crop production of Ontario. Farmers who are unable to get skilled labor are more apt to leave their old timothy sods for several years before being broken up. An old timothy sod in a dry season furnishes but little pasture. The pasture lands of Ontario could be greatly improved. A large number of varieties of grasses, clovers, and grains have been tested at the Ontario Agricultural College, both singly and in combination for the production of pasture. The results are presented under three separate headings.

Annual Crop for Pasture.—Until recently but little was said or known in regard to annual pasture crops, or in other words, the sowing of crops in the spring for the production of pasture in the same year. Enquiries were frequently

made by farmers as to what could be sown in the spring of the year which would furnish the best results in pasture in the same season. Practically no information could be gleaned from the results of experiments which had been carried on elsewhere. It was, therefore, the place of this institution to inaugurate a line of experiments to discover which varieties or mixtures of varieties would form the most suitable temporary pastures, and as the result of testing seventeen crops separately, and in six different combinations within the past eighteen years we have gleaned information which we believe to be of some service. If a farmer realizes in the autumn or in the early spring that his pasture crop is going to be deficient for his requirements during the coming summer, and writes to us for information as to what he can use to the best advantage we are in a position to give him an intelligent answer. For average conditions in Ontario we have found the following combination to be the most serviceable for sowing in the spring for producing a pasture in the same year, viz., Oats, 51 lbs.; Early Amber Sorghum,



Dairy herd in Annual Pasture which was produced from 51 pounds Oats, 30 pounds Early Amber Sugar Cane, and 7 pounds of Common Red Clover seed per acre.

30 lbs.; and common Red Clover Seed, 7 lbs.; making a total of 88 lbs. of seed per acre.

The oats and the sorghum are mixed together, and are sown from the grain box of the seed drill, and the clover is sown from the grass seed box placed in front of the tubes of the drill. If this mixture is sown during the first week in May, it is usually ready for pasture about the 20th of June. The oats are early and rapid in growth; the sorghum is later, stools well and thrives in hot weather; and the clover forms the principal pasture in the autumn. All varieties are readily eaten by the animals, especially the oats and the sorghum. If desirable, the clover may be allowed to remain over winter to furnish one or two cuttings in the following year. The tramping by the cattle has not caused any marked degree of injury, either to the plants or to the soil.

In each of the past nine years we have had from eight to ten acres of this annual pasture in our experimental grounds. Steers were used in each of five years, milch cows in each of three years, and heifers were used one year, for pasturing the crop. The pasture has been sufficient to carry an average of about one and

one-fifth cattle per acre per season. The animals have thrived splendidly in each of the nine years. No trouble whatever has been caused by bloating and the animals have been in the best of health. The steers gained on an average about two pounds per day and the cows gave good satisfaction in the production of milk. This pasture is now being used considerably in actual practice and the experience of farmers seems to indicate that it has given pretty general satisfaction.

Pasture Crop for Two or More Years. Many farmers seed their grain with timothy and common red clover, and, after taking off one crop of hay, use the land for pasture until it is again plowed. The clover soon disappears, and the timothy forms a comparatively poor pasture, especially in dry seasons. The following mixture in pounds per acre is better for pasture purposes:—Red Clover, 6 lbs.; Alsike Clover, 3 lbs.; Orchard Grass, 3 lbs.; Meadow Fescue, 3 lbs.; and Timothy, 3 lbs.; making a total of 18 lbs.

This mixture can be sown in the spring of the year, either with or without a grain crop. It should be sown in front of the tube drill; the clover and the timothy from the grass seed box, and the orchard grass and meadow fescue by



Individual plants of Orchard Grass grown in the nursery plot, and from which seed of the best plants were selected in order to start new and improved strains.

hand. It could be used as a hay crop in the following year, and for pasture afterwards. In comparison with timothy, this mixture will start earlier in the spring, produce a greener growth in the hot, dry months of the summer, and furnish a more abundant growth of leaves in the autumn.

Crop for Permanent Pasture.—Land which is not required in the regular rotation of the farm can often be seeded with a permanent pasture mixture to excellent advantage. From more than twenty years' work in testing different varieties of grasses and clovers, both singly and in combination, I would suggest the following mixture in pounds per acre for a permanent pasture under average conditions of soil, drainage and climate: Alfalfa or Lucerne, 5 lbs.; Alsike Clover, 2 lbs.; White or Dutch Clover, 2 lbs.; Orchard Grass, 4 lbs.; Meadow Fescue, 4 lbs.; Tall Oat Grass, 3 lbs.; Meadow Foxtail, 2 lbs.; and Timothy, 2 lbs.; making a total of 24 lbs.

The seed of this permanent pasture mixture can be sown in the early spring, either with or without a grain crop. It is better to follow some cultivated crop which has been carefully looked after during the previous season. If the seed is

sown alone the tops of the plants should be cut occasionally during the summer and allowed to lie on the ground as a mulch. If a nurse crop is used, about one bushel of barley or of wheat per acre is recommended. As a rule, oats do not form a good nurse crop for a permanent pasture mixture. The seed for the permanent pasture should be sown in front and not behind the tube drill. Some of the finer seeds can be sown from the grass seed box, and the others by hand.

Such a mixture as this, when once well established on suitable land, should produce a good pasture, appetizing to the animals, excellent in quality, abundant in growth, and permanent in character.

ALFALFA GROWING IN ONTARIO.

The experiences in alfalfa growing in Ontario are still quite varied. We have abundant evidence, however, to show that alfalfa can be grown successfully in many parts of this Province. It is also grown in each of the other Provinces of the Dominion but to a much more limited extent. In order to grow alfalfa successfully in this Province it is of the utmost importance that the best methods for its cultivation be followed. These include the use of a proper variety of alfalfa, the condition of the soil and the subsoil, the amount of water or moisture in the land, the method of sowing, the time of sowing, the care of the crop, etc. The following table gives the yields per acre of the different cuttings of green fodder and hay as produced at the College in each of seventeen years:

Years.	Green Crop.					Hay.				
	First Cutting.	Second Cutting.	Third Cutting.	Fourth Cutting.	Total.	First Cutting.	Second Cutting.	Third Cutting.	Fourth Cutting.	Total.
	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.
1896.....	9.96	6.47	4.06	2.05	22.55	8.08	1.91	1.29	.65	6.93
1897.....	12.04	5.61	4.42	.....	22.06	8.59	1.56	1.23	.....	6.38
1898.....	9.71	5.85	2.64	.....	18.20	2.30	1.75	.63	.....	4.68
1900.....	11.98	6.00	1.60	.....	19.53	2.33	1.47	.80	.....	4.60
1901.....	9.70	2.20	7.49	.....	19.39	2.08	1.00	1.50	.....	4.53
1902.....	13.35	8.69	2.98	.....	25.00	2.50	2.02	.54	.....	5.06
1903.....	13.10	8.53	2.75	.....	24.38	2.50	2.09	.67	.....	5.25
1904.....	12.45	9.35	4.00	.....	25.80	3.40	2.50	1.08	.....	6.98
1906.....	9.73	6.60	4.85	.....	21.23	2.55	1.13	.58	.....	4.26
1907.....	14.55	3.95	.....	.....	18.50	2.95	1.05	.....	.....	4.00
1908.....	9.70	6.75	3.73	.....	20.18	2.50	1.15	.75	.....	4.40
1909.....	8.68	4.56	.84	.....	14.08	2.52	1.40	.14	.....	4.06
1910.....	15.08	3.38	4.76	.....	23.72	2.94	.80	1.32	.....	5.06
1911.....	8.00	1.80	1.36	.....	11.16	1.76	.34	.30	.....	2.40
1912.....	9.48	4.68	4.72	.....	18.88	2.08	.99	.56	.....	3.63
1913.....	9.51	2.96	1.90	.....	14.37	2.55	.91	.62	.....	4.08
1914.....	7.46	1.63	2.83	.....	11.97	2.27	.51	.73	.....	3.51
Average 17 yrs.....	10.85	5.27	3.23	.12	19.47	2.58	1.33	.75	.04	4.69

In experiments extending over a period of seventeen years the alfalfa has given an average of three cuttings per year with a total annual production of 19.47 tons of green crop and 4.69 tons of hay per acre. These results have been obtained from experiments conducted in different parts of the experimental grounds and from different seedings. In every case the crop was sown in the spring of the year, and at the rate of from eighteen to twenty pounds of alfalfa seed per acre, and usually with a grain crop such as barley sown at the rate of one bushel per acre. The average dates of cutting for the seventeen years were June 21st for the first,

July 31st for the second and September 19th for the third. As a rule the first crop in the season has been about double that of the second, and the second crop has been about double that of the third. In some years the yields of alfalfa per acre have been about twice as large as those of other years.

Besides experimental work at the College co-operative experiments have been conducted throughout Ontario, through the medium of the Ontario Agricultural College and Experimental Union. This work has enabled us to glean information regarding the success of alfalfa under varying conditions throughout Ontario. Alfalfa usually thrives on a good fertile soil of almost any character, providing it is furnished with the proper kind of subsoil. It does particularly well, however, on undulating clay land except on the lowest portions. Good results cannot be expected from growing alfalfa on land which has a cold, sour, wet subsoil which is deficient in lime. It is probably safe to say that the under soil has a greater influence than the soil at the surface in making the conditions favorable or unfavorable for the successful cultivation of these deep rooted plants. It is necessary to grow alfalfa on land which is well underdrained. If the land has a good natural drainage and is not too dry and open alfalfa find conditions very favorable for the development of its deep roots, and for its continuous growth from year to year.



Two rows of Grimm Alfalfa, which show decided hardiness in comparison with those on either side, which are tender varieties and unsuited for cultivation in Ontario.

If these conditions do not exist naturally, however, owing to a lack of underdrainage it is very necessary to drain the land to a good depth in order to permit the alfalfa roots to enter the subsoil. If the water level is near the surface the alfalfa plants usually die in a short time.

From extensive enquiries made throughout Ontario we learn that alfalfa is grown most extensively in the Counties of Haldimand, Lincoln, Welland, Wentworth, Brant, and Lambton, although it is grown considerably in a number of the other counties, and to a more or less limited extent in practically every county of the Province.

According to the reports of the Bureau of Industries for the Province of Ontario, alfalfa was grown on 189,959 acres in 1912, on 167,707 acres in 1913, and on 163,685 acres in 1914. This shows a decrease of over 22,000 acres in one year and of over 26,000 acres in two years. The large decrease was undoubtedly due to large areas being sown of tender varieties which were badly killed out.

Alfalfa seed can be produced successfully in several places in Ontario, and in sections of the Western Provinces. In these different sections of the country there

is probably no place more suitable for alfalfa seed production in Ontario than on the rolling clay land extending along Grand River, and from Brantford, Caledonia and Cayuga, eastward through the central part of the Niagara Peninsula. Prof. Smith, now of the Agricultural College of Maryland, and formerly in charge of the United States alfalfa work east of the Mississippi River, informed the writer that he considered the Niagara Peninsula in Ontario more suitable for alfalfa seed production than any other portion of the country east of the Mississippi River. The section of the country coming next to the Niagara district in this respect was the district around Utica, New York. In the Niagara Peninsula the soil is very suitable, as shown from the fact that alfalfa has been grown in that district successfully for more than forty years, and during that time a hardy strain of alfalfa has been developed, which is now known as the Ontario Variegated. In the Western Provinces it seems evident that a considerable amount of alfalfa seed will be produced in Southern Alberta in the semi-arid country. Although the climate is severe in parts of that country the dry condition of the soil permits the alfalfa to thrive comparatively well. The Milk River valley in Montana, just



An alfalfa seed field of Ontario Variegated Alfalfa grown on the College Farm.

south of the Canadian border, is becoming a noted alfalfa growing district. It is possible that sections of Alberta may become noted for the production of hardy alfalfa seed in the near future. I understand that alfalfa seed has been produced successfully in Manitoba in 1914 for the first time. Mr. J. H. Irwin, located on the Government Farm at Neepawa, wrote me under date of December the 13th as follows: "In reply to your letter of recent date I would say the alfalfa grown on our farm is the true Grimms' alfalfa. It yielded four and one-quarter bushels per acre." Mr. Irwin obtained in all about twenty-five bushels of seed. This was a very good yield indeed. I believe there is a great future for alfalfa in Canada and we are realizing more and more the importance of variety, which up to a very short time ago was almost entirely ignored.

In some parts of Ontario the production of alfalfa seed is becoming quite an industry. As both a crop of hay and a crop of seed can be produced in the same season many of the alfalfa growers find seed production quite profitable. The production of alfalfa seed is important not only to those who actually produce the seed, but also to the farmers who are thus enabled to secure seed which has been

produced in a climate which is similar to that under which the crop is to be grown. From extensive enquiries made from farmers who have grown alfalfa seed in Ontario for at least five years, some very valuable information has been obtained. We learned that alfalfa seed had been produced with success in at least thirteen counties in Ontario. In all cases where seed was produced it was taken from the second crop, the first crop of the season being converted into hay. The yield of alfalfa seed per acre varied considerably, the highest being seven bushels, and the average a little over two bushels per acre. The farmers determined the time for cutting the crop for seed production by the color of the pods, most of them stating that the crop should be cut when the pods were brown, although some of them left the crop until the pods were almost black. The majority of the farmers cut their seed with a mowing machine, and a number mentioned having a table attachment to the machine. About twenty per cent. used the reaper, and about twelve per cent. used the self-binder. As a rule the crop was cured in the windrow by those who used the mowing machine, and in the bunches by those who used the reaper, or the mowing machine with the table attachment. Those who used the self binder cured the crop in shocks. The threshing was done mostly with a clover machine, and took place almost any time after the crop was harvested until midwinter. When the threshing is done in the autumn it is preferable to have dry weather, and when in the winter to have cold weather in order to get the best results. Nearly all farmers have reported obtaining good quality of seed in most years. The seed has been sold chiefly to neighboring farmers and to local dealers. The greatest difficulties reported in alfalfa seed production in Ontario have been from the injuries caused by grasshoppers, wet weather, blighted plants, early frosts, and a few mentioned troubles from thick seeding. The ideal condition appears to be a comparatively moist season for the production of the hay crop, and a rather dry season after the hay has been removed from the land. Nearly all the farmers stated that they considered seed production did not injure the plants. Nearly all were enthusiastic alfalfa growers from the standpoint of both hay and seed production. Unfortunately the last two or three years in Ontario have been more unfavorable for seed production than almost any of the fifteen years previous. Many of the farmers in the Niagara Peninsula have either used their own seed or have bought the seed from their neighbors. In this way the same strain has been used for a longer period of time, and many of the tender plants have become killed out. Although this system has been conducive to the production of a hardy strain of alfalfa it has at the same time permitted the growth of a considerable number of weeds along with the alfalfa. In the last few years a number of the best farmers have been endeavoring to produce the hardy alfalfa as free from weeds as possible. I believe that this section of the country will in time become a noted district for the production of a large quantity of hardy alfalfa seed to the advantage, not only of the farmers who produce the seed, but also to the advantage of many other farmers throughout Canada who are anxious to buy hardy alfalfa seed for use on their own farms. There is a great opportunity for seed producing centres where the hardy alfalfa can be grown so successfully for the production of both hay and seed.

Alfalfa is a deep-rooted leguminous plant, perennial in its habit of growth, and under favorable conditions will live and produce crops for many years. Formerly, it was called Lucerne in the eastern part of America, but the word "Alfalfa" is now used almost universally. We have had under experiment at the Ontario

Agricultural College four different species or types of alfalfa which are here described somewhat in detail.

Common or violet alfalfa (*Medicago sativa*), is the species which has been grown extensively for centuries in some of the comparatively warm countries of the world. It is this type of alfalfa which is grown almost entirely in Central America, and in Mexico, and in Texas, California, Utah, Colorado, Nebraska, and Kansas, and in other southern and central states of the American Union. The plants of the Common alfalfa have an upright growth and numerous stems which grow from the crowns of the roots. The flowers are violet in color, the coloring matter appearing in different degrees of density, extending from a comparatively deep to a very pale violet, the latter being almost white. The seed pods are coiled in two or three spirals, the seeds are kidney-shaped, and are about one-twelfth inch in length.

Variegated alfalfa (*Medicago media*), is supposed to be a natural cross between the *medicago sativa* and the *medicago falcata*. The plants are mostly upright,



A group of farmers listening to a talk on Ontario Variegated Alfalfa, the flowers of which are variegated in color, being composed of violet, blue, green and yellow, and various blends of these with each other.

but some have a spreading habit of growth. The flowers are variegated in color, and besides the violet include shades of blue, green and yellow, and various blends of these with each other and with violet. The seed of the Variegated closely resembles that of the Common alfalfa.

Yellow Lucerne (*Medicago falcata*), grows wild in some of the European and the Asiatic countries, and is considered to be very hardy. It generally has a spreading habit of growth, the stems being somewhat slender, and the leaves rather narrow. The flowers are yellow in color, the seed pods are sickle-shaped, and the seeds are somewhat smaller than those of the Common alfalfa.

The hairy-stemmed Yellow Lucerne (*Medicago ruthenica*), has a spreading habit of growth, yellow flowers with brownish centres, seeds brownish in color, flattened, distinctly lobed, and less kidney-shaped than those of the Common alfalfa.

There are many varieties of alfalfa. These have obtained their names largely from the countries in which they have been grown for a length of time, from the men who have become prominent in the introduction or the improvement of alfalfa, from the color of the alfalfa flowers, etc. While some of these different kinds do not vary from each other to any great extent, from a botanical standpoint, there are some marked variations in hardiness and in productiveness.

Of the different varieties of Variegated alfalfa which have been grown at the College, the Grimm, the Ontario Variegated, the Sand and the Baltic have all given satisfactory yields, and have proven hardy. Of the Common or Violet alfalfa, the Turkestan seed obtained from Asia has given fairly satisfactory results. In no case has the seed of the Common variety, which has been obtained from the United States, given satisfactory results. Seed of the Common variety was obtained from Texas, Kansas, Nebraska, Colorado, Utah and Montana, and in every case the plants have been badly winter killed. The Common variety grown in Ontario has given fairly good results, being superior to the Common alfalfa ob-



A few alfalfa plots, showing the Ontario Variegated in the front, the Grimm farthest away, and the Common alfalfa from the Western States in the centre. The reader will observe how tender the alfalfa obtained from Colorado, Utah, Nebraska and Texas is in comparison with the other two hardy varieties.

tained from each of the States of the American Union, but inferior to the Variegated alfalfa grown in Ontario.

As the result of numerous experiments I consider that particular attention should be given at the present time to the increase of pure seed of the Grimm and the Ontario Variegated varieties of alfalfa.

At the Ontario Agricultural College we have made various selections of these alfalfas, and also of the Sand Lucernes and of the Yellow-flowered falcata, and the results are exceedingly interesting and quite promising. We found one plant with creeping root stalks which was sending shoots to the surface and producing new plants from twelve to fifteen inches from the mother plant. This was a very interesting specimen, and we now have a considerable number of plants obtained through cuttings from the original plant. I simply mention this to show that there is room for excellent work, and that the new strains which will in time be developed will undoubtedly be of great value to the agriculture of Ontario and to Canada.

In 1912, One Thousand Dollars of Federal money was set aside for the testing of these varieties in the different counties of Ontario. In 1913 twenty pounds of seed of the Ontario Variegated was sent to each of twenty-two District Representatives. In each case the seed was to be sown on one acre of land, divided into four equal parts, one-quarter of the land to receive inoculated seed and no lime; another quarter, inoculated seed and lime; another, uninoculated seed and no lime; and still another, uninoculated seed and lime.

In 1913 Ontario Variegated seed was almost a failure in the Province. We, therefore, imported from Minnesota, North Dakota, and Montana about eight hundred pounds of the best seed obtainable of the Grimm alfalfa. This cost from fifty to seventy-five cents per pound. In the early part of 1914 sufficient seed for sowing three acres of land was sent to each of sixteen District Representatives for sowing in July with the object of seed production. Part of the seed was to be sown in rows at different quantities per acre, and part was to be sown broadcast. This should furnish information in regard to the hardiness of the Grimm alfalfa in the different Counties; the suitability of the different Counties for seed production; and the most likely method of sowing to give the best results. Besides this, seed was sent, through the District Representatives, to members of the Alfalfa Seed Circle in Haldimand County, and to others sufficient for sowing at least sixteen acres. It will, therefore, be seen that over sixty acres of Grimm alfalfa were sown in Ontario last year with a definite object of seed production.

CONCLUSION.

In order to get the best results in crop production in Ontario in the coming year many things should be carried out in a practical and a systematic way. Plans for crop production should be made as long before seeding time as possible. Careful attention should be given to the use of those crops which would best meet the present demands in furnishing the most suitable food materials for home consumption and for export, and also the most serviceable feeds for farm stock. If the best varieties are not already secured efforts should be made to procure the varieties which would likely give the best satisfaction. Care should be taken in grading the seed in order to get large, plump, sound seed of strong vitality, and entirely free from impurities of all kinds. This work should be completed before the spring opens. As soon as the land is dry enough and warm enough to work to good advantage in the spring, everything should be ready for early and thorough cultivation. All crops should be sown or planted at the proper time. In the sowing of grain, for instance, spring wheat should be placed in the ground as early as possible, followed by barley, oats, and peas in the order here mentioned, and all should be sown within ten days, if possible, after the land is suitable for cultivation. Care should be taken in the best methods of sowing, and in the proper quantities per acre, not only of the grain, but also of the corn, roots and all other farm crops. If these and other points are carried out with great care it is surprising what can be accomplished in the improvement of crop production in Ontario.

It is the earnest hope of the writer of this bulletin that the results here submitted will prove of real value in the advancement of crop production in Ontario and that the information imparted may assist the farmers not only to help themselves but to help others as well, and thus assist in the progress and the betterment of mankind.

INDEX

Introduction	1
Field Experimental Work	2
Weather Conditions in 1914	4
Comparative Yield of Different Classes of Farm Crops	5
Rotation of Crops	6
Increase in Farm Crops	7
Continuous Growing of Varieties without Change of Seed	8
Increased Production Resulting from Superior Varieties	8
Influence of Seed Selection	10
Improved Varieties by means of Selection and of Hybridization	12
Co-operative Experiments in Agriculture	13
Loose Smut in Oats, and Stinking Smut in Wheat	14
Smut Resistance in Oats	17
Amounts of Oats to Sow per Acre	18
Grains Grown in Combinations for Grain Production	19
Varieties of Spring Barley	19
Varieties of Winter Barley	23
Varieties of Oats	23
Two New and Popular Varieties of Oats	26
Percentage of Hull in Oats	29
A Test of the Stooling of Oats	30
Classification of Wheat	31
Varieties of Winter Wheat	32
New Varieties of Winter Wheat	34
Varieties of Spring Wheat for Flour Production	34
Varieties of Macaroni Spring Wheat	35
Emmer and Spelt for the Production of Grain for Feeding Purposes	36
Wheat of Other Species	37
Varieties of Rye	38
O. A. C. No. 61 Rye	39
Varieties of Buckwheat	39
Varieties of Field Peas	40
Varieties of Field Beans	41
Varieties of Soya or Soja Beans	42
Vetches for Seed Production	43
Grass Peas	43
Cow Peas	44
Varieties of Flax for Seed Production	44
Varieties of Millet for Seed Production	44
Sunflowers for Seed Production	46
Varieties of Corn for Grain Production	46
Varieties of Sorghum for Seed	47
Experiments in Potato Growing	47
The Production of Root Crops in Ontario	49
Varieties of Mangels	50
Varieties of Sugar Beets and Sugar Mangels	52
Varieties of Swede Turnips	53
Varieties of Fall Turnips	54
Varieties of Field Carrots	55
Varieties of Kohl Rabi	56
Varieties of Parsnips	56
The Production of Field Root Seed in Ontario	57
Varieties of Corn for the Silo and for Fodder	59
Varieties of Sorghum for Fodder	64
Varieties of Millet for the Production of Fodder	65
Dates of Sowing Millet	67
Sunflowers for Fodder	67
Varieties of Rape, Cow Cabbage, Kale, etc.	67
Miscellaneous Leguminous Crops for Green Fodder	69
Pasture Crops in Ontario	70
Annual Crop for Pasture	70
Pasture Crop for Two or More Years	72
Crov. for Permanent Pasture	72
Alfalfa Growing in Ontario	73
Conclusion	79

LIST OF BULLETINS

PUBLISHED BY THE ONTARIO DEPARTMENT OF AGRICULTURE, TORONTO

No.	Date	Title	Editor
181	June 1910	The Teeth and Their Care	Ont. Dental Society
182	July 1910	Bee-keeping in Ontario	Fruit Branch
183	Aug. 1910	Notes on Cheddar Cheese-making	Dairy Branch
184	Nov. 1910	Uses of Vegetables, Fruits and Nuts	
185	Nov. 1910	Little Peach Disease	E. Casar
186	Dec. 1910	Children: Care and Training	E. J. Kahan
187	Jan. 1911	The Codling Moth	L. Chew
188	April 1911	Woods of Ontario (No. 126 revised)	J. H. Howitt
189	May 1911	Farm Poultry No. 181 revised	W. R. Graham
190	May 1911	Bee Diseases in Ontario	Fruit Branch
191	June 1911	Bee-keeping in Ontario	Fruit Branch
192	July 1911	Agricultural Cooperation	A. L. Todd
193	Nov. 1911	Tuberculosis of Poultry	E. P. Edwards
194	Dec. 1911	Apple Orcharding	Fruit Branch
195	Jan. 1912	Insecticides and Fungicides (No. 134 revised)	E. Harcourt
196	Jan. 1912	Tomatoes	H. L. Palmer
197	Feb. 1912	Bee Diseases in Ontario	A. D. Turvey
198	Feb. 1912	Lime-Sulphur Wash	Marion Pettit
199	Feb. 1912	Onions	E. Casar
200	April 1912	Fruit Juices	A. McManis
201	May 1912	Peach Growing in Ontario	A. McManis
202	May 1912	Peach Diseases	E. P. Edwards
203	May 1912	Grass Growing in Windsor Parklands	E. Casar
204	May 1912	Cabbage and Cauliflower	T. H. Barrett
205	June 1912	Diseases of the Teeth	A. McManis
206	Sept. 1912	Dairy School Bulletin (No. 113 revised)	Ont. Dental Society
207	Nov. 1912	I. Cheese-Making and Butter Making	
208	Nov. 1912	Dairy School Bulletin (No. 119 revised)	Head of Dairy School
209	Dec. 1912	II. Dairying on the Farm	
210	Dec. 1912	Ice-Cell Storage on the Farm	R. H. Graham
211	Jan. 1913	Farm Poultry and Egg Marketing Conditions in Ontario County	J. H. Hare
212	Mar. 1913	Farm Forestry (No. 145 revised)	G. A. Benson
213	Mar. 1913	Strawberry Culture and The Red Raspberry	E. J. Davis
214	Mar. 1913	Fruits Recommended for Ontario Farmers (No. 179 revised)	F. M. Clement
215	April 1913	Orchard Surveys at Dundas, Stormont and Glengarry	Fruit Branch
216	April 1913	Bee Diseases in Ontario	F. S. Hare
217	May 1913	Sheep Raising in Ontario: Does it Pay?	Marion Pettit
218	Aug. 1913	Demonstration Lectures in Domestic Science: Sewing and Darning	Live Stock Branch
219	Oct. 1913	Bee Feeding of Apples	Institute Branch
220	Dec. 1913	Farm Poultry (No. 182 revised)	H. P. Palmer
221	Dec. 1913	Birds of Ontario (No. 170 revised)	W. R. Graham
222	Jan. 1914	The San Jose and Oyster-Shell Scales	A. C. McCollough
223	Mar. 1914	Lightning Rods	G. W. Nash
224	April 1914	Food Value of Milk and Its Products	E. Casar
225	April 1914	Currents and Consequences	W. H. Day
226	May 1914	Fertilizers	R. Harcourt
227	Sept. 1914	Greenhouse Construction	H. P. Palmer
228	Dec. 1914	Swine	E. Harcourt
229	Dec. 1914	Flam Culture in Ontario	A. L. Gibson
230	Jan. 1915	Cherry Fruit-Flies	G. O. Johnston
231	Feb. 1915	Farm Crops: Experiments at O.A.C.	G. M. Day
			F. M. Clement
			L. Chew
			G. J. Spencer
			G. A. Navin